SCIENTIFIC AMERICAN

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HOLLY'S NEW PUMPING ENGINE AND AUTOMATIC PRESSURE REGULATOR.

Mr. Holly's first works were established in the city of Lockport, N. Y., for fire protection alone, and proved eminently satisfactory. Three years later works on the Holly plan, combining daily supply with fire protection, were built in the city of Auburn, N. Y. The machinery first used in the Lockport works consisted only of a rotary pump, a turbine wheel, and a hydrostatic regulator. Improvements have been made in the mechanism until the compound pumping engine, said to be equal to any other in style, finish, and duty, was produced. This engine, which is the subject of our illustration, was first introduced at the Rochester, N. Y., Water Works in 1873.

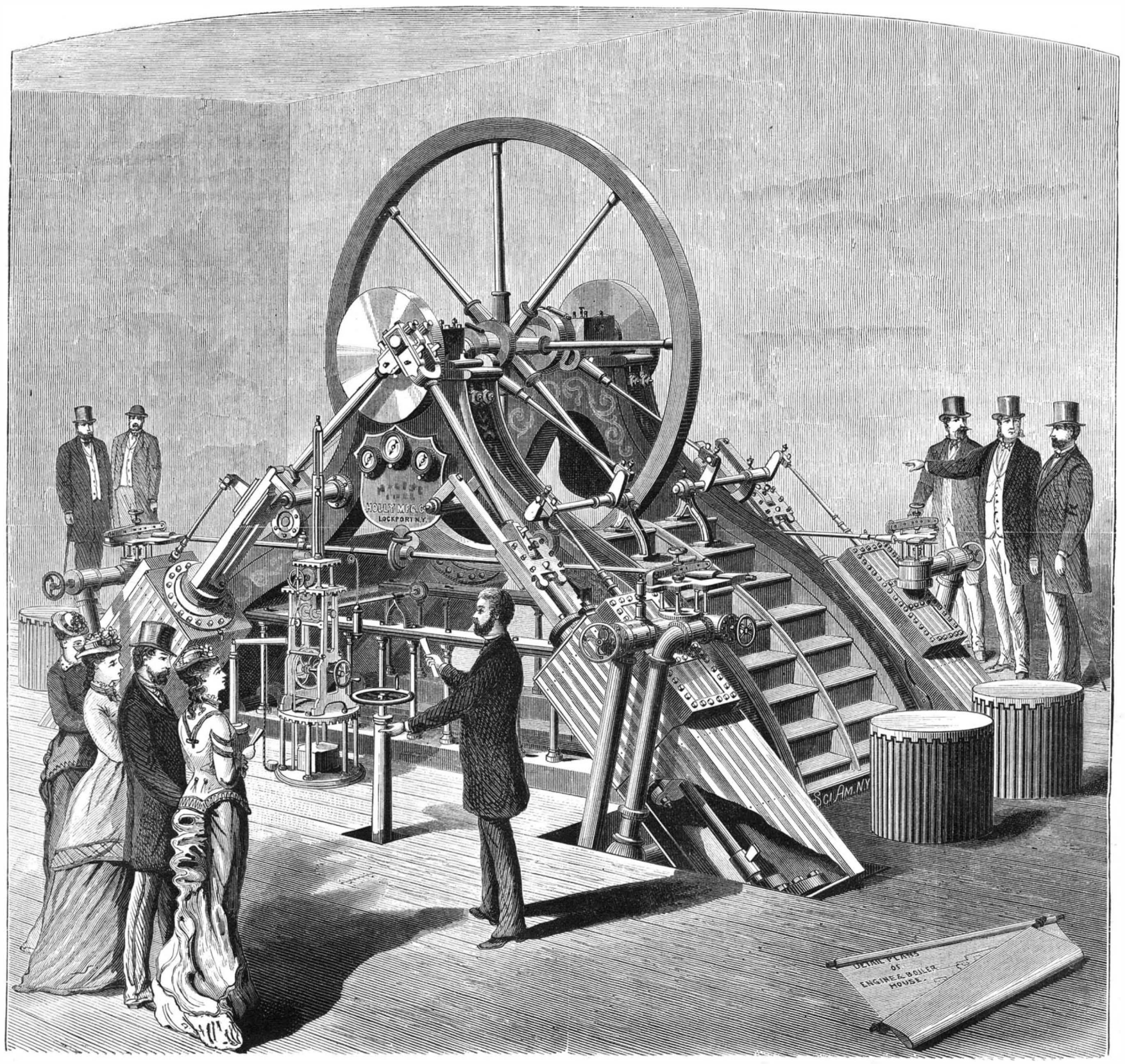
The engine consists of four steam cylinders, having four corresponding reciprocating pumps attached by direct connections, and erected on a heavy arched double frame of iron, set at an angle of 90°, one steam cylinder and its pump being placed at each of the four corners. The frame supports at its top a shaft with an overhanging crank on either end, to which the four engines are connected by ordinary connecting rods. The cylinders and pumps are detached at pleasure, and may be run singly, in pairs, or all together, according to the demands for water supply. The engine is provided with the usual air pump and jet or surface condenser, and by a peculiar arrangement of pipes and valves may be run on either the high, low, or compound steam pressure principle, and may be changed from one to another at any moment by the engineer. This arrangement is necessary to secure economical daily pumping for domestic supply, which is done by compounding steam, and prompt increase of power for efficient fire protection, which is amply secured by converting the machine into a high pressure engine. When compounding, the steam is taken directly from the boilers into one of the cylinders and exhausted into the remaining three; and when running high pressure, steam is taken directly into all of the cylinders, the latter operation increasing the power of the whole, four to eight times. To supply this increase reserve boilers are provided, and to guard against a failure in the water supply duplicate engines are added when the demands of consumers equal one half the capacity of the engines first erected.

The water is pumped directly into the main, and by means of ingenious contrivances, invented by Mr. Holly, the pressure of the water in the main is made to control the operation of the engines, and in fact to perform faithfully the duty of an engineer.

These contrivances are a successful substitute for the costly and cumbersome reservoir. They provide for varying pressure, according to varying requirements of communities, whether it be for moderate daily supply or added fire pressure. The varying draughts of water from street mains will add to or diminish pressure in distributing pipes. This variation in pressure in these mains will act upon the regulator placed by the side of the pumping engine, and it in turn quickens or slows the engine to supply just what water is needed. This method of Mr. Holly is new. Starting with the idea of providing a better and more effectual method of fire suppression than is afforded by movable fire engines, multiplied and costly experiments enabled him to combine with it daily supply without the intermediate agency of the reservoir or stand pipe. This system will not only supply cities with water for ordinary purposes at any desired elevation, but it will also furnish the means of extinguishing fires at several points at the same time if necessary, without the use of movable engines for that purpose.

The Holly engine has shown a duty of 76,250,000 ft. lbs. per 100 lbs. of coal. This proves that the Holly pumping engine, as now manufactured, will compare with the best on the score of economy.

It is claimed that the direct or Holly plan commends itself as preferable to the reservoir plan, because the original ex-



HOLLY'S NEW PUMPING ENGINE AND AUTOMATIC PRESSURE REGULATOR.

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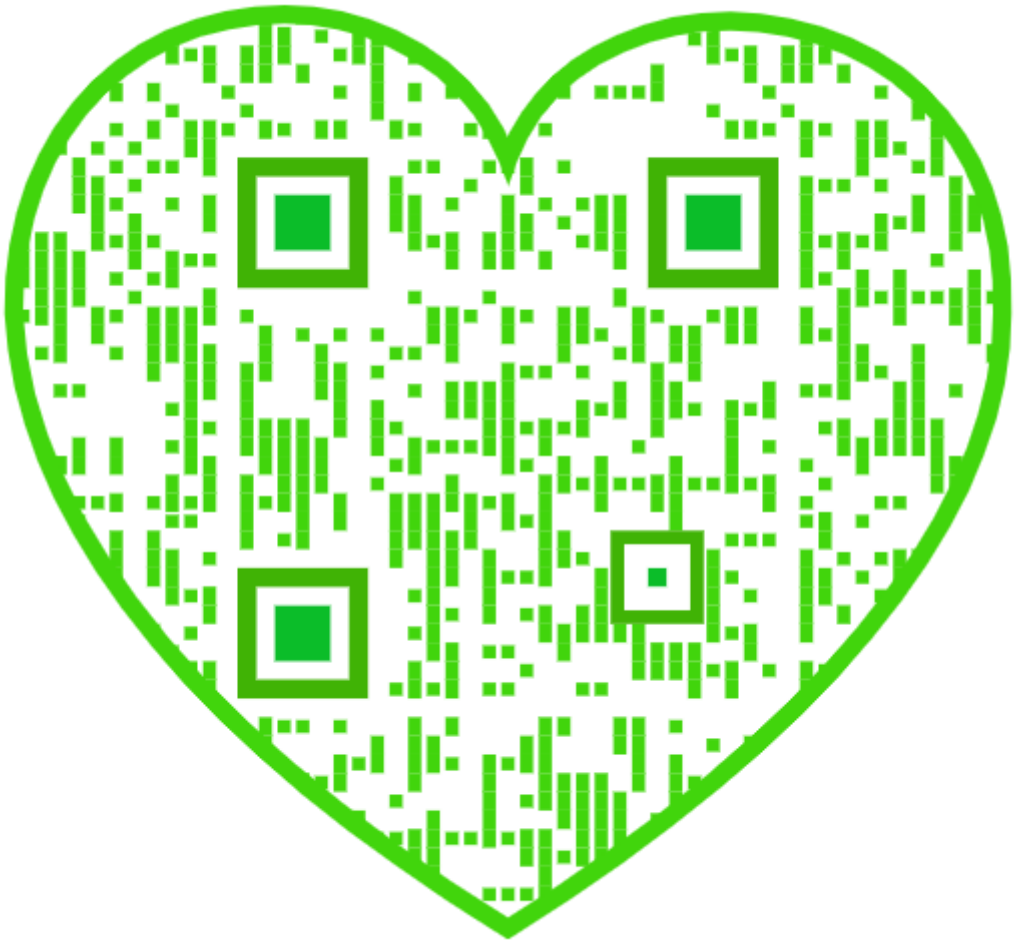

pense will be less; the annual cost (including interest on debt) will be reduced; the supply will be more regular and reliable throughout the town, including the highest ground; it will not be subjected to as much danger of being cut off by casualties, it will make every hydrant a powerful fire engine, which can be used to put out fires more successfully than by the movable engines which must be used in connection with gravitation works. Under the Holly system there are increased barriers against large conflagrations, and protection against large and fearful losses.

We are informed that underwriters recognize the introduction of this improved method of fire suppression as a reason for reduction in insurance rates.

The validity of Mr. Holly's claims has been disputed by imitators; but the courts have recently, after a long and sharply contested suit, rendered a decision in Mr. Holly's favor, sustaining the broad claim of a new and improved method of supplying cities with water.

The Holly system of water supply and fire protection is in use in 69 of the principal cities and villages in the United States. For further information address the Holly Manufacturing Co., Lockport, N. Y.

STEAM ON COMMON ROADS.

Two years ago the Legislature of Wisconsin offered a prize of $10,000 for a successful road motor, propelled by steam or otherwise, to be used as a substitute for draught cattle on common roads, and for ordinary agricultural work, as in plowing, thrashing, etc. The text of the law was printed in the SCIENTIFIC AMERICAN for January 29, 1876. The test of success was to be the performance of a journey of at least two hundred miles on the common roads of the State at an average rate of five miles an hour, working time. It was also stipulated that the machine should be so constructed as to run in the ordinary wagon track, to be able to run backward and turn out of the road for the passage of other vehicles, and to be able to overcome a grade of at least two hundred feet to the mile. A board of three Commissioners, including Mr. G. M. Marshall, the member to whom the passage of the law was chiefly due, was appointed by the Governor to witness the prescribed test, and such others as they might suggest.

The effect of the law has clearly been to stimulate in a marked degree the inventors of the State, seeing that at a competitive trial appointed for July 15 two Wisconsin machines were entered, and others from Milwaukee and Madison had been offered, but failed to appear at the advertised time for starting.

The competing machines were the "Oshkosh," invented by Schomer & Farrand, of Oshkosh, and the "Green Bay," owned by the Cowles Brothers, of East Green Bay. The latter proved the more speedy for short distances, but broke down so often that it was practically out of the race. The "Oshkosh" made the trip from Fort Howard to Madison—201 miles—in 33h. 27m., thus beating the prescribed time over 6½ hours. Over the sand hills between Waupun and Watertown the machine is said to have traversed 32 miles in a little over four hours. Another quick run was made between Watertown and Fort Atkinson, 21 miles, in two hours and ten minutes. Most of the distance traveled is said to have been through heavy sand and gravel. The engineers report no breakages on the trip, no scaring of teams, and not a bridge plank disturbed. Throughout the trip the machine hauled a wagon weighing 3,500 lbs. While on exhibition at Oshkosh this load was increased by about five tons of green lumber. The machine alone weighs 4,800 lbs., with water and fuel 6,600 lbs. At Fort Atkinson a plowing trial was had, the details of which have not come to us.

The advantages to be gained by the adaptation of steam to ordinary road traction are enormous, and the behavior of the "Oshkosh" shows that practical success in this direction is not far off. The wisdom of the Wisconsin Legislature in offering the bounty needs no better demonstration. The result is pretty sure to be one, perhaps several, practical motors, which must add greatly to the industrial power and wealth not only of Wisconsin, but of the world.

The Commissioners report that the "Oshkosh" not only made the prescribed trip of 200 miles within the time allowed, but also hauled loads, plowed, and otherwise accomplished in a successful manner every test mentioned in the law or suggested by the Commission. They are not satisfied, however, that the machine is, in the spirit of the law, "a cheap and practical substitute for the use of horses and other animals on the highways and farms." They find it unquestionably of great advantage in plowing, thrashing, and heavy hauling from farm to farm, and on the highways, but it costs $1,000, and requires a daily expenditure of from $2 to $6 to run it. Consequently the Commissioners decline to give it the prize offered by the Legislature, though they propose that the Legislature shall make a proper award for what has already been accomplished. Seeing that nearly three years remain before the time of the legislative offer expires, there would seem to be still a sufficient opportunity for inventors to win the prize, and, as a matter of course, the larger fortune which surely awaits the creator of a practical motor for common roads.

THE 28th Annual Exhibition of the Maryland Institute for the Promotion of the Mechanic Arts will open on Wednesday, October 2, at Baltimore, and continue for five weeks. For particulars see advertisement in another column.

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THE ECLIPSE OF THE SUN, JULY 29, 1878.

In accordance with previous calculations the moon occupied such a position, on the above date, between the sun and the earth, as to throw its shadow upon the latter, causing a total eclipse of the sun's light throughout a long stretch in this country and a partial eclipse elsewhere. The path of the total eclipse here was 116 miles wide and about 2,000 miles in length, beginning at the northwest corner of Idaho and extending through parts of Montana, Wyoming, Colorado, Kansas, New Mexico, Indian Territory, Texas, and Louisiana.

Favorable weather prevailed all along the line of totality, except to a limited extent in Texas, and all the parties of observation report excellent results. East of the Mississippi no observations of value were made, the sun being obscured by clouds.

From Rawlins, Wyoming Territory, Professor Henry Draper reported four splendid photographs of the corona. Two, taken with his large diffraction grating, show the corona to have a continuous spectrum; thus indicating that the light of the corona is derived by reflection from the sun, and is not that of an ignited gas. The photograph of the corona taken with the large equatorial is described as very sharp and full of detail. Edison's tasimeter distinctly showed the heat of the corona, but was too sensitively adjusted. The observations made with it demonstrated that the heat of the corona is much greater than that of the fixed stars, but exact measurements were impossible, the heat throwing the light ray entirely off the galvanometer scale. Professor Barker's observations showed no bright lines in either the inner or the outer corona. The green line could not be detected, nor were any protuberances seen. The Fraunhofer lines were observed by both Dr. Draper and Professor Barker, and their observations were confirmed by those of Professor Morton. The last named described the corona as brilliantly white, with a marked prolongation of bright rays in a direction diagonal to the horizon. His observations proved the light of the corona to be radially polarized. He saw no protuberances.

At Separation, Wyoming, Professors Lockyer, Newcomb, and Watson obtained equally good results. Professor Lockyer observed the eclipse with a small Rutherfurd grating in front of an ordinary camera. His observations confirm those of Dr. Draper. The corona was much less bright than during the eclipse observed in India, and new phenomena were consequently visible. Professor Newcomb thinks that he detected a new fixed star in the vicinity of the sun, but further researches will be needed to confirm the observation. Professor Watson is quite positive that he saw an inter-Mercurial planet—possibly the much-disputed Vulcan—about 2½° from the sun, appearing like a star of 4½ magnitude.

From Pike's Peak, Colorado, Professor Langley reported successful observations by Gen. Meyer and the Washington and Pittsburg party. The corona was elongated, twelve diameters of the sun on one side and three on the other. It resembled the zodiacal light. At Denver, Professor Young discovered no ultra red or ultra violet lines. At the moment of totality the Fraunhofer lines were beautifully reversed, confirming observations made in Siam. Both of the H lines were reversed. Very bright lines were seen near B, confirming Poyson's observations. Professor Young also saw as bright lines F and 1474 Kirchhoff. Professor Colbert's observations tended to show the moon's path to lie further to the southward than is indicated by the lunar tables, or else that the estimate of the moon's diameter is too large; perhaps both. Measurements made by Mr. Easterday indicated that the corona extended fully 700,000 miles outward from the sun. The chromosphere was distinctly seen by Professor Hough, indicating a thickness of some 2,000 miles. No prominent protuberances were seen.

The Naval Observatory party at Creston, W. T., were quite successful. Professor Harkness, assisted by Lieut. Sturdy, searched for ultra violet lines, using a Rutherfurd diffraction grating, but found none. With the equatorial camera, Messrs. Clarke and Skinner obtained six good photographs, and Prof. Robinson four with a polariscopic camera.

At Santa Fé, New Mexico, Professor Rock, astronomer of the Wheeler Survey, assisted by Signal Observer Frost, made successful observations of contact, and obtained a valuable series of meteorological observations.

At Fort Worth, Texas, the four contacts were observed under the most favorable conditions. Five photographs were taken during totality, two of them polariscopic. The results confirm those of Professors Young and Harkness. The reversal of the Fraunhofer lines was observed, and line 1474 was measured. Three large pearl-white prominences were seen.

At West Las Animas, Colorado, only a few small prominences were seen. The contacts were later than the American ephemeris prediction, and the duration shorter. Observations of the corona were numerous and successful. At other points less important observations were made. The reports concerning the effect of the darkness on the lower orders of creation are very conflicting. The darkness was marked, but not intense.

Altogether the results obtained by the various parties of observation are such as to promise great additions to our knowledge of the sun, as soon as they can be properly worked out.

A PASTE formed by mixing powdered glass with a concentrated solution of silicate of soda makes an excellent acid proof cement.

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THE DISCOURAGEMENT OF INVENTION.

We have received from inventors not a few communications with regard to the threatened changes in the patent law, in every instance sustaining the position taken by the SCIENTIFIC AMERICAN, that the proposed increase in the cost of patents, and the limitation of the right of the patentee, would have an immediate effect in diminishing the number of useful inventions.

Touching section 11 of Mr. Wadleigh's bill, an inventor writes: "I would say that my experience, being a man of limited means, has been that it takes a long time to get a patent in paying condition. Machine shops will burn up and destroy your patterns, and you have to begin again. Your patterns want changing and simplifying, and before you get a machine ready to put upon the market you have several worthless machines which cost money and discourage a man enough without having to pay any more. It is now four years since I patented my miter box, and six years since I began to work at it; and it is just now that it is doing me any good. I am at work on another invention which I shall patent as soon as I can, if that law does not pass; if it does pass I shall have to abandon the work, for I shall not dare to incur the risk."

Another inventor, after quoting the declaration of Mr. Sargent, of the Western Railway Association, as cited by Mr. Walker before the Patent Committee—"Whenever our attention is called to a patent of value we use it, and in a few cases we are made to pay by plucky inventors; but in the aggregate we pay much less than if we took licenses at first"—goes on to say: "I have made an invention for use on railroads, which if adopted would beyond question prevent disasters now by no means uncommon—disasters wherein life and property are often largely sacrificed, and consequently the loss of large sums of money by the corporations in payment of damages, and all this loss comes out of the stockholders' dividends. The millions of travelers also on our railroads have a right to all the safeguards possible, and should not be deprived of them. I have got the model for my invention above mentioned nearly completed, and intended in a short time to apply for a patent. But the declaration of the railroad officer above quoted, coupled with the prospect that the nefarious law proposed will be forced through Congress by the machinations of parties interested in the entire destruction of the patent laws of the country, induces me to abandon the idea of taking out a patent, and I shall leave the invention where it is. I cannot afford to fight for my rights against pirates backed up by Congress, and it is highly probable that scores of useful inventions now in process of development will for the above reasons be abandoned by their authors."

In a long letter on the incentive which a good patent law offers to the inventor, in which he says that the hope of gain under the patent law has been his only incentive to invent, another correspondent writes:

"Take away the patent system, deprive thereby the inventor of his hoped for reward, and every inventor would argue in this way to himself: 'If I follow this idea up and perfect it, undergo the drudgery, disappointments, and expense, and bring a useful and valuable form out of this chaotic idea, and call the attention of the public to it, what will be my reward? I shall probably be in the position of one of the dogs of Constantinople when he finds a large piece of meat or bone and ventures to display himself in the streets therewith. His share would not pay for the trouble of finding it.' Therefore the *ci-devant* inventor would say, 'I cannot afford to spend so much time and money as would be required, simply *pro bono publico*, so I will leave it for some one who can.' And the one who is rich enough to be able to afford to spend so much for patriotic motives solely would be apt to have more tempting immediate inducements in established enterprises to occupy his attention, and invention would cease."

It is altogether likely that the attempt to modify the patent law in the interest of infringers will be renewed as soon as Congress meets again. In the meantime it will be well for inventors and all others who have at heart the industrial progress and prosperity of the country to see that their representatives do not return to Congress unwarned and uninstructed. The ignorance which many otherwise intelligent members displayed last winter with regard to the extent of the country's industrial interests, and the vital influence of the patent system upon their prosperity, was positively appalling. The risk should not be repeated.

WHERE OUR INVENTORS LIVE.

The geographical distribution of our inventors is, to say the least, suggestive in respect to the number of patents taken. The leading States stood, in 1876, as follows: New York, 3,914 patents; Pennsylvania, 1,895; Massachusetts, 1,298; Illinois, 1,298; Ohio, 1,195; Connecticut, 736; New Jersey, 685; Michigan, Indiana, Iowa, Missouri, and California stand close together, about 425; Wisconsin took 303; Maryland, 273; Rhode Island, 231; District of Columbia, 197; Maine, 178; Minnesota, 164; Kentucky, 163; Virginia, 145; Texas, 108; Tennessee and Louisiana, 107 each; New Hampshire, 107; the rest less than 100 each. It will be seen that New York took more than double the next in the list; while the first three took more than all the rest together. Massachusetts took more than all the rest of New England, and 200 more than all the States south of Mason and Dixon's line. The number taken in Connecticut exceeded by 120 the share of all the South Atlantic and Gulf States from Virginia to Texas. New York took more than all New England, except Massachusetts, and all the South; Illinois nearly as many as all the Southern States together; Missouri and Maryland more than the rest of the South, excepting Kentucky and Tennessee; and the last two more than the Carolinas, Georgia, Florida, Alabama, and Mississippi. In the ratio of patents to population, the leading States were: The District of Columbia, with 1 to 668 inhabitants; Connecticut, 1 to 730; Rhode Island, 1 to 914; Massachusetts, 1 to 918; New York, 1 to 1,121; New Jersey, 1 to 1,323; California, 1 to 1,376; Pennsylvania, 1 to 1,859; Illinois, 1 to 1,957; and Ohio with 1 to 2,230. The proportion for the United States as a whole was 1 to 2,398 inhabitants. The southern coast States averaged about one patent to twenty thousand inhabitants.

NOT SO MANY OUT OF WORK.

That the financial disasters and industrial changes of recent years have thrown many operatives and laborers out of work, and at the same time have necessitated a redistribution of labor that has borne heavily upon many industrious people, is sadly true. Yet it is certain that the number of willing workers who cannot find employment throughout the country is very much less than demagogues—who want to manipulate the "labor vote"—have tried to make out. They talk of millions begging for work and groaning in enforced idleness; but no one else can discover them. The truth is that while many are doing work which they would prefer not to do, at rates below what they think themselves worth, the great majority of our working classes are well employed, and the thrifty among them find that their diminished earnings now have quite as great a purchasing power as had their higher wages (in a depreciated currency) years ago.

No small part of the failure of would-be workers to win employment is due to their unwillingness or incapacity to adjust themselves to the changed condition of the labor market. During the period of flush times and political rings, great swarms of laborers were gathered about all our cities, nominally to work upon city improvements, really to serve their employers at the polls. They were paid not so much for their intelligence and strength as for their service on election day; and subsequently, when they found it impossible to get similar work to do, too many of them showed little inclination to grapple with serious work in other occupations. Used to large wages and light work, they had no stomach for hard work and small pay, and were besides unwilling to exchange their gregarious life for the severer and less exciting life of the country laborer. Too many of them also preferred to leave their families to the care of charity while they "agitated" for public employment.

A more deserving class of more or less skilled workers came to temporary distress through the transference to the West of numerous industries formerly monopolized by the East. A large migration of Eastern mechanics and artisans was thus made necessary; and many of those who were unable or unwilling to follow their work had to suffer, though for no fault of their own, the penalty of being not wanted. But the worst is over now. To a large extent the needed readjustments have been made; industry has revived; the demand for labor is increasing; and the return to the soil of large numbers of men who ought never to have abandoned it has considerably lessened the competition in other fields of labor. Accordingly the great army of the unemployed, that demagogues talk so much about, has dwindled to comparative insignificance. Of the remnant the larger portion is manifestly composed of the tramp element, which dreads nothing so much as steady employment.

The labor census in progress in Massachusetts furnishes instructive evidence in this connection. Massachusetts is a State in which the manufacturing industry largely predominates. In its mills and factories the introduction of new and improved machinery has been general and rapid. And within late years its manufactures have been seriously crowded in many markets by the rapidly developing manufactures of the central West. Yet in Massachusetts to-day the number of persons lacking regular employment is surprisingly small. Already enough of the State has been canvassed to warrant the chief of the State Bureau of the Statistics of Labor, Mr. Carroll D. Wright, in fixing the maximum number of men without permanent employment in the whole State at twenty thousand. Of this number at least a third have occasional employment; and half the rest belong to the unsteady and thriftless class, who never work if they can avoid it. Accordingly the number of men in Massachusetts who want work and cannot get it is estimated at not more than ten thousand—a large number considered by themselves, but small compared with the whole number of workers, or with the number so often said to be out of work. In proportion to her population, Massachusetts' share of Kearney's 4,000,000 tramps should be at least 175,000. For our part we put more confidence in Mr. Wright.

THE PARTITION OF TURKEY.

The territory taken from Turkey by the treaty of Berlin comprises an area considerably exceeding that of all New England, or about 71,500 square miles. The largest section, Bosnia, handed over to Austria, is nearly as large as the State of South Carolina, or all the New England States except Maine. Its area is 33,000 square miles, and its population upward of 1,000,000. Austria also receives a small tract (30 square miles) at the southeastern corner of Montenegro. The last named warlike little state gets an adjoining strip of territory covering nearly 15,000 square miles, with a population of about 40,000, an area a little larger than Rhode Island. Servia receives the greater part of the Valley of Upper Moravia, some 3,000 square miles, with a population of 200,000. Roumania gets the Dobrudja, 5,000 square miles, and about 200,000 inhabitants, an area somewhat larger than that of Connecticut. But at the same time Roumania surrenders to Russia the portion of Bessarabia alienated in 1856, covering 3,300 square miles, and sustaining a population nearly equal to that of the Dobrudja. The new tributary principality of Bulgaria extends from Sophia and Widdin on the west to Varna and Silistria on the east, an area as large as West Virginia, 23,000 square miles, with a population of nearly 1,800,000. South of Bulgaria is he new province of Eastern Roumelia. Greece has got nothing so far, but the promised rectification of her frontier will probably advance it to a line running from the Adriatic shore, near the southern end of the island of Corfu, across Mt. Pindus to the mouth of the Salamvria river, on the Ægean Sea. At the eastern end of the Black Sea, Russia receives an accession of territory amounting to nearly 9,000 square miles, with about a third of a million people.

ARTIFICIAL INDIGO.

The most notable achievement in synthetic chemistry since 1868 has just been made by Professor A. Baeyer, Professor Liebig's successor at Munich. For the past twenty years he has been studying the constitution of indigo, and at a late session of the German Chemical Society he announced the completion of his task in the discovery of the last link in the chain of synthetic reactions leading to the artificial formation of that important dyestuff. This discovery ranks with that of Professors Graebe and Liebermann in 1868, by which artificial madder was substituted in the arts for the natural product, hitherto the only instance of the kind in the history of chemistry. As yet the operations involved in this synthesis are too numerous and too costly to allow their practical application in the arts; yet there is reason to expect that cheaper methods will be devised, as was the case with artificial madder products, and that before many years a new and important industry will be developed. At the same time the present occupation of many people will be destroyed, and large areas now devoted to the cultivation of indigo will have to be put to other uses.

PROGRESS OF LABOR SAVING MACHINERY IN THE SOUTH.

One of the most notable signs of the change which is going on in the Southern States is the increased interest shown by the people of that section in inventions and improved machinery. Northern and Western people, accustomed to daily sight and use of the numerous handy and work-saving appliances with which their homes abound, would be struck with amazement could they see the lack that exists in the South of even what are looked upon as necessities by the poor in Northern States. This is not because of poverty, as the same state of affairs exists in Southern homes, whether it be in the house of a two thousand acre farmer or a more humble proprietor.

A ludicrous illustration of ignorance in regard to house conveniences was recently seen in a place not more than two hundred miles south of Philadelphia, when a crowd of citizens were collected around a cast iron sink brought by a Northern family just settling there. Not one in the crowd could guess the object or purpose of the mysterious article, and yet most of them were very intelligent people, and one a physician and college graduate standing high in his profession.

One cause of this was that heretofore necessity did not compel the adoption of labor-saving devices. To use the expression of a Southerner, "Miss Chivalry sat in her room, and when she wanted a drink of water obtained it by ordering it brought; and it was the same thing to her whether the well was in the kitchen or a mile away, her wants were satisfied."

To show the gradual increase of interest taken in new inventions by the people of the old slave States, it is only necessary to refer to the statistics of the Patent Office. Taking simply the last six years for illustration, during the year 1871 the number of patents granted to citizens of Alabama was in proportion of 1 for every 34,400 inhabitants, while in 1877 it was 1 for every 23,418; to citizens of South Carolina in 1871 it was 1 patent for every 27,139 inhabitants, while in 1877 it was 1 for every 20,753.

Taking Tennessee as a border State, the proportion in 1871 was 1 patent for every 12,100 inhabitants, while in 1877 it was 1 for every 11,039.

The agricultural State of Indiana had patents granted to her citizens in 1871 in proportion of 1 to every 4,277 inhabitants, and in 1877, 1 to every 3,734. The manufacturing State of Connecticut in 1871 had a patent granted for every 806 inhabitants, and in 1877, 1 to every 885. These facts show that some parts of the South have gained, while some Northern States have not kept up their proportion.

These signs are hopeful, and with the increase of the middle class of people, the class that uses and appreciates modern inventions for daily use, and the growth of manufacturing interests, Southern soil will produce both inventors and inventions in profusion.

ACCORDING to a Paris journal, the locks displayed in the American Department at the Exhibition are incomparably finer and more perfect in every way than anything of the kind ever before seen in Europe, at any rate in France.

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American Cotton in China.

Speaking of the increased sales of American cotton goods in China, the British Consular report for 1876 states that "America seems bent on imitating Great Britain in her products, and has actually shipped to China large quantities of heavy cottons termed continental sheetings, but in reality a cross between a good gray shirting and a T-cloth. Although hitherto these sheetings have resulted in loss only, both to the importers and manufacturers, yet they are genuine articles, free from over-size and all the other adulterations employed in the Lancashire mills, and not being liable, therefore, to mildew, they bid fair to assert a front place in the foreign trade with China. It will be a long time, however, before it utterly supplants the British textile which it seeks to resemble. China clay and the other deleterious substances are less costly than pure cotton; the cost of production in England is far below that in America, and until lately the Chinese have always run after the cheaper commodity, as long as it possessed sufficient cohesiveness and held together under the needle, and did not fall to pieces in a shower of rain."

Now that the Chinese are learning to "run after" goods that are durable as well as cheap, the Lancashire process of loading cottons with China clay bids fair to bring its practicers to grief. It is to be hoped that no American manufacturer will be so foolish as to follow the English example.

NEW COTTON SPOOLING MACHINE.

We illustrate herewith an improved spooler devised by S. F. Cobb, of Alberton, Md., who claims the said spooler can be run 25 per cent faster than those ordinarily constructed, without causing any breakage of the yarn when nearing the barrel of the bobbin, as is commonly the case with the majority of spooling machines, and thereby securing the yarn upon the spool that is usually wound off into waste; also that all knots, bad piecings, and double ends are removed by the thread guide. The spool, A, is rotated in the usual way by frictional contact with a rotating drum, B; the ends of its spindle enter vertical guide grooves in the arches or transverse frames, C, so that as the spool becomes gradually filled with thread wound thereon from the bobbin, D, it will rise in said grooves until the ends of the spindle fall into lateral recesses communicating with the grooves. The thread passes off the bobbin through the slotted guide, E, Fig. 2, which is attached to the traversing bar, F. The said guide differs from those ordinarily used in spooling machines, in that the respective arms of the same are provided with barbs or hooks, *a a*, projecting inward from their upper ends, and caused to press together by reason of their own elasticity; the object being to prevent the thread being raised or lifted out of the guide by the attendant. The frequent temptation to the attendant to thus remove the thread from the guide arises from the formation of bunches or knots in the thread, which are too large to pass through the guide, and should be broken out, and the thread neatly tied. This construction of guide effectually prevents this, and compels the operator to remove the bunch or knots and tie the thread so that it may continue to be drawn through the guide. The traversing bar, F, is arranged to work in guides formed by slotting the sides of the arches, C, to receive the bar, thus bringing the bar close to the side of the cam, H. The cam is in the form of a hollow cylinder having an endless slot which extends diagonally nearly the length of the cylinder on two sides, thus having a V shape at the points where the grooves return, or passes from one side of the cylinder to the other. An arm, G, carrying a friction sleeve, projects from the traverse bar and works in the said groove. The bar is caused to traverse a distance of the length of the spool, A, between its heads, thus laying the threads thereon evenly and perfectly. A traverse bar, F, is arranged on each side of the cam, the form of the slot causing the respective bars to reciprocate in opposite directions, and winding the thread upon two different sets of spools operated simultaneously by the same drum. The cam is secured upon a short shaft, I, by means of a set screw, so that it may be adjusted longitudinally, as required by the wear of the edges of the cam groove, or the guide, or other cause. A spur groove is formed on the outer end of the same, and meshes with a pinion, J, which forms part of the gearing by which motion is communicated to the cam shaft, and thereby to the cam itself, and likewise secures a more compact arrangement of gearing, greater economy in the manufacture of the machine, and less friction in its operation.

This machine can be seen in operation at the Alberton Mills, Md. Patented through the Scientific American Patent Agency. For further particulars address the inventor, as above.

A NEW WORKING GLOVE.

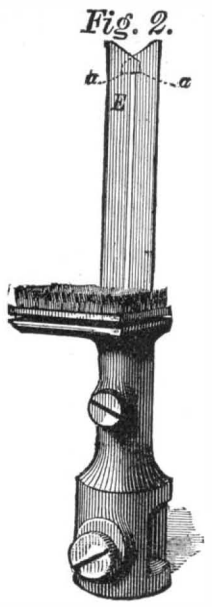
Ordinary gloves, such as are used in husking corn and doing other similar kinds of work, wear out first upon the tips of the fingers and thumb, and upon the ball of the thumb. To obviate this unequal wear, and to render the

TOWNSEND'S WORKING GLOVE.

glove more serviceable, Mr. Cyrus M. Townsend, of Standing Rock, Dakota Ter., has devised the glove shown in the engraving.

The body of this glove is of the ordinary form and materials, and to its inner or palm side are attached pieces of cloth upon which, in places subjected to the greatest wear, there are surfaces that are covered with a protecting coating of sand and rubber. Instead of applying the protective coating to the cloth in this manner, it may be applied directly to the face of the glove.

Fig. 2.



Spooling Machine Guide.

The rubber coating protects the glove and renders it waterproof at the points to which it is applied, and the sand assists materially in removing the husks from corn; it also renders the glove more effective in grasping objects of any description.

Patented through the Scientific American Patent Agency, May 21, 1878. For further particulars address the inventor, as above.

Public Heating by Steam.

Auburn contemplates the introduction of the Holly system of steam heating, and at a recent meeting of citizens to consider the project some very interesting statements were made by Mr. Holly and others relative to the working of the system in Lockport last winter. To test the system financially somethree miles of main pipes had been laid through sparsely settled neighborhoods, and several houses heated by steam. Each consumer contributed the amount of his previous year's coal bills, and the amount reimbursed the company for expenses.

This was thought a thorough test, since in a thickly settled district the system would work more economically and profitably: the extreme mildness of the winter, however, may have been an element worth considering. The mains ran up hill and down, and the loss from condensation was small, less than three per cent on a mile of pipe when the full capacity of the main was used; the water so formed was carried along with the steam into the houses, where it was collected, with that from the service pipes, in reservoirs, giving a supply of pure soft water for domestic purposes. The cost of fitting up a house of "good average size" with radiators, pipes, etc., ready to be heated by steam, was one hundred and thirty-five dollars. The cooking done by steam heat was highly commended.

Lighter and Keener Tools and Implements.

As implements made of steel are lighter, stronger, and keener than those of iron, so are they better adapted to use by manual labor, by horse power, or by the power of water and steam. A man walks easier with light shoes, light clothes, and spends his time more directly upon the work before him in proportion as there is less labor between himself and that work. Give a man an iron ax, and he, besides becoming discouraged, finds his blows to tell less efficiently and with less precision than when there is an edge of sharp steel between his hands and the tree. The same applies with all kinds of blunt, unscientifically shaped implements. A hoe of right inclination will go under and lift the soil while another will drag over it. A lipped drill will go under the grain of a Bessemer steel rail, while such a drill as is ordinarily used in boring cast iron will only operate to render the fibers more compact, and will have about the same difference of effect in boring as a blunt and a sharp edged ax do in cutting. Every carpenter knows the difference in a properly and improperly filed saw, and in two different lipped augers. A sloping plowshare will scour and run lightly under the soil, while a blunt one will clog and drag through it with difficulty. The same is true of the cutting edge of a turning tool for iron, wood, or steel, orthe plane for either of these.

With the discovery of a process for cheaper steel, it is practical to give a very much diminished weight of metal in carriages and carts as well as in railroad cars and any other machinery requiring strength and lightness. The chief success of American manufactures in competition with the older nations, where labor is cheaper and manufacturing longer and more economically established, is their lightness, strength, and peculiar adaptability to the labor they are to perform.

A ditch digger handling a shovel weighing but five pounds and lifting five pounds of dirt will work with much more animation and to much more purpose than if raising five pounds of dirt on a shovel weighing ten pounds. The same is true in all mechanical appliances and powers, whether of a pump, a steam engine, a water wheel, or any other. The cost of raising dead weight is often the difference between failure and success.

New Mechanical Inventions.

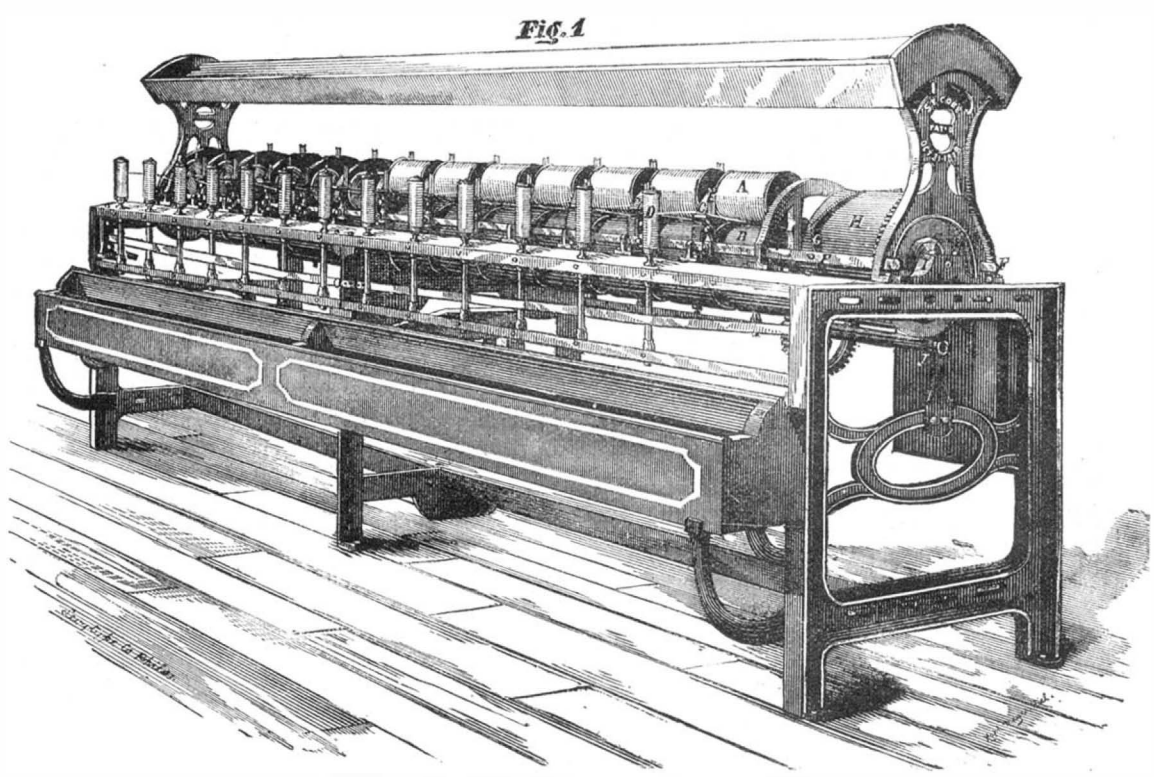
An improved Double-acting Pump has been patented by Henry J. Humphrey, of Grundy Center, Iowa, and Luther C. Humphrey, of Augusta, Wis. This invention relates to double-acting lift and force pumps, and it consists in a barrel containing two double pistons, the rods of which pass through slots in the side of the barrels, and are connected with a lever fulcrumed at the top of the pump stock.

George J. Kautz, of Emporium, Pa., has patented an improved Device for Rolling and Turning Logs in sawmills. The log is rolled by the engagement of teeth with its outer surface, and the bar which carries the teeth is constantly drawn forward into engagement with the log by a weight.

Gaylord Bell, of Cheyenne, Wyoming Ter., has patented an improved Driving Attachment for sewing machines, lathes, scroll saws, and other light machinery, by which the same may be run evenly and effectively by the pressure of the foot, avoiding dead centers, and the possibility of running backward so as to break the thread.

Wilhelm Meissner, of New York city, is the inventor of an improved Music Box, having a cylinder provided with pins and a screw wheel. The cylinder, when rotated, operates a set of hammers which strike upon the plates of a "metallophone," and produce clear bell tones.

Fig. 1



NEW COTTON SPOOLING MACHINE.

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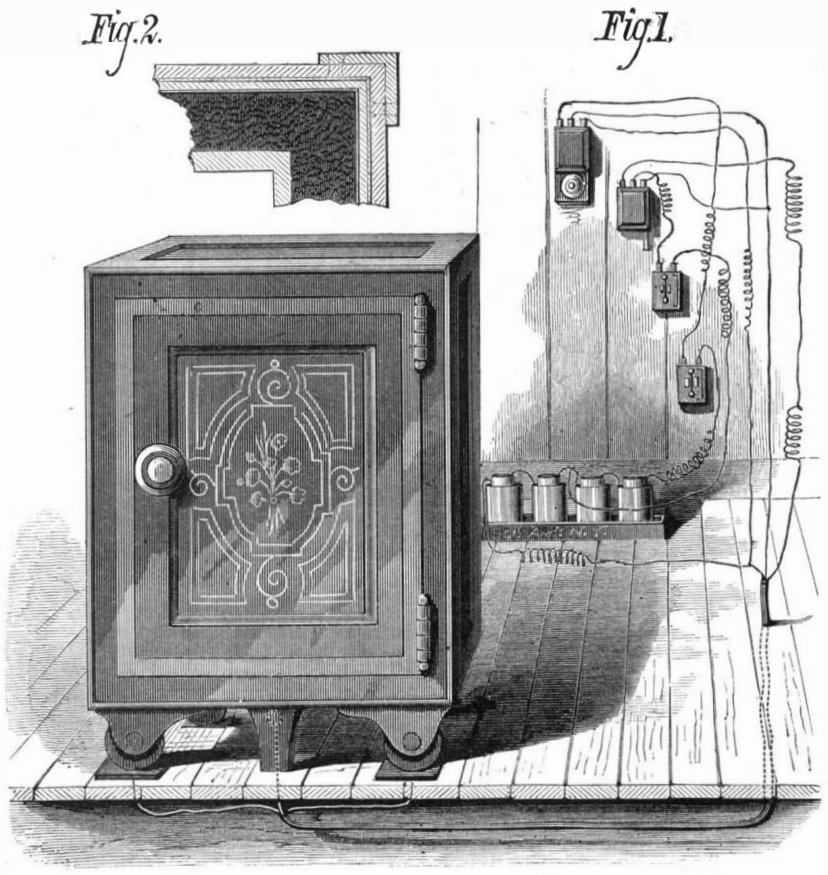
ELECTRO-MAGNETIC BURGLAR ALARM SAFE.

This invention, which is shown in the accompanying engraving, consists in a certain construction and arrangement of safes in connection with magnetic or electric wires, a battery and an alarm apparatus, by which the drilling, forcible breaking or opening as well as removal of safes is prevented.

The safe is constructed in such a way that it is impossible to tamper with it without it gives an alarm, either by drilling, forcible breaking, insertion of key, or by turning the knob of a combination lock, through which the outer wall of the safe is connected with an inner insulating plate running on all sides and door thereof, or by moving the safe, which stands on plates inserted in the floor; the safe being moved from it will break the circuit of the current, connected with a relay, provided with an anchor, which will fall off, giving an alarm, as soon as the safe is moved, the same being the case if the wires should be cut connecting with the safe. The alarm thus brought into motion will keep on ringing until released, the alarm being provided with circuit breakers, which may be put to rest during the day. The alarm apparatus can be placed in any suitable place about the house, police station, night watchman's room, etc. The safe does not differ in appearance from any other. We are informed that this alarm can also be affixed to old safes.

The wires, which for convenience in the present case are connected with the front of the safe, will, in practice, be connected with the back, where they will be out of the way and out of sight.

This invention was recently patented by Mr. Max Koloseus, 123 East Houston street, New York, from whom furthur particulars may be obtained.



ELECTRO-MAGNETIC BURGLAR ALARM SAFE.

The Beet.

The original stock of the beet occurs wild on the shores of the Mediterranean Sea, in Greece, and grows wild in some of the islands of the Atlantic Ocean. This is the common mangold, of which there are two subspecies. It was cultivated for food by the Greeks, as it is at the present day by the Persians and natives of India. The Romans were acquainted with two varieties. Charlemagne ordered the cultivation of the beet on his estate, and from this it was distributed throughout Europe, and has extended to North America.

NEW CORN PLOW AND MARKER.

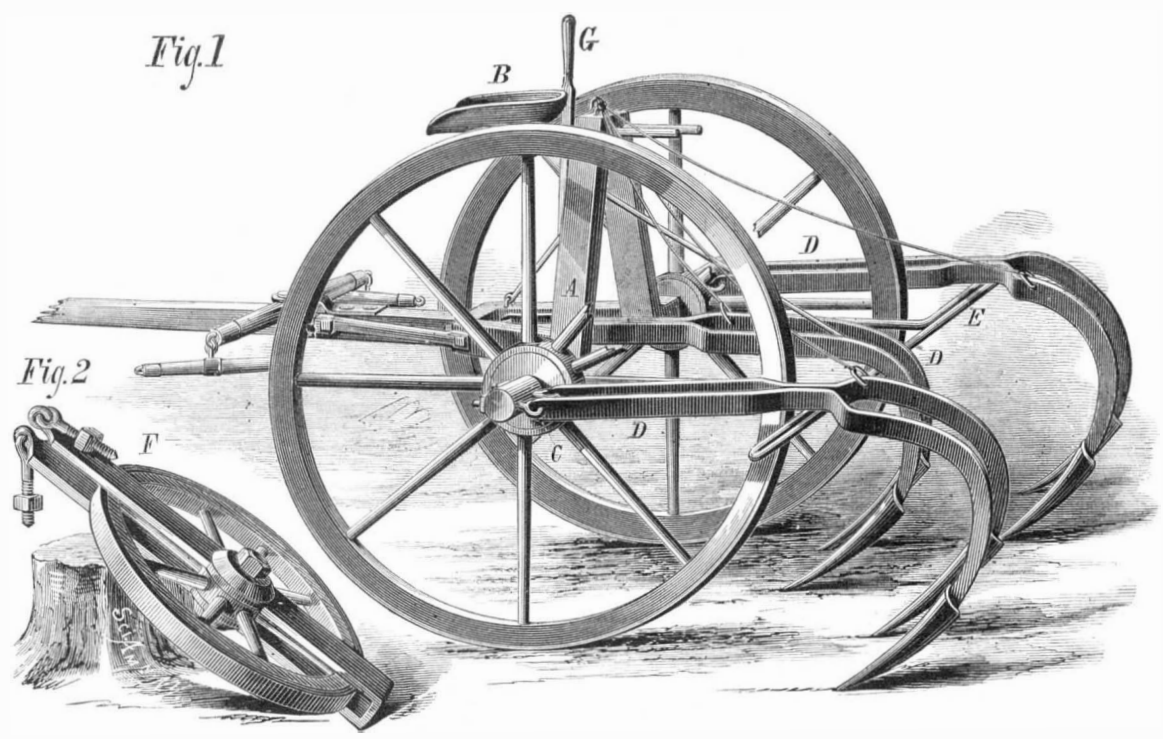
Our engraving represents an implement by means of which land can be laid off in squares for corn planting, and it may readily be converted into a plow for cultivating the corn after it has attained sufficient height.

The axle is made of one continuous piece of steel or iron, and is bent forward at its center to receive the tongue and the supports of the middle marking wheel. The spindles of the axle are made much longer than usual to permit of moving the wheels outward toward the ends of the axle.

An iron bar, A, is secured to the axle, and has in it two holes for receiving the rods that project rearwardly from the seat, B. This seat is made adjustable so that it may be moved back and forth, so that the driver can adjust his weight to the machine, and thus balance it so that there will be no weight on the necks of the horses.

A number of hook bolts, C, pass through the axle for receiving the ends of the beams, D, and supporting rod, E. When the implement is used for marking, the outer wheels are placed at the ends of the axle, and the wheel, F, shown in Fig. 2 of the engraving, is attached to the axle by means of the middle pair of hook bolts. The wheel, F, is free to move up or down, by this arrangement each wheel will mark the ground distinctly, no matter how rough or uneven it may be. The implement is converted into a corn plow by removing the wheel, F, and moving the wheels from the ends of the axle inward against the shoulders of the axle, and a double plow is attached to each end of the axle and one is attached to the middle.

The supporting rod, E, extends under all of the plow beams and prevents the plows from entering too deeply into the ground. A lever, G, is connected with the supporting rod, E, for raising and lowering the plow beams, and to each pair of plow beams a strap or chain is attached, by means of which the driver may raise any pair of plows should it become necessary. When it is desired to increase the distance between the plows a wooden block may be inserted between the beams of each pair at a point where they are bent inward and joined together. For further particulars address the inventor, Mr. Charles M. Burns, Hamler, Ohio.



BURNS' CORN PLOW AND MARKER.

New Miscellaneous Inventions.

Mr. Jerome D. Bruce, of Newberry, S. C., has patented an improved Bale Tie, the buckle of which is constructed with a rounded pintle at one end, and with flat opposing faces, which constitute a longitudinal channel through the buckle to give passage to one end of the bale band, the buckle being made to turn a half revolution upon its pintle after the other free end of the band has been inserted longitudinally, so that the free end of the band is bent twice and securely fastened.

Mr. Charles Jackson, of California, Ohio, has patented an improved Bake Pan for baking and roasting various kinds of food, popping corn, roasting coffee, and for other similar purposes.

An improved Harness Buckle has been patented by Mr. Samuel M. Hamilton, of Fort Smith, Sébastian Co., Ark. Heretofore the hook of back band or trace carrier buckles have been constructed in one piece with the straight or flat frame thereof, and the sliding cross bar, which serves as a tongue, has been made detachable. The improvement consists in providing the buckle frame with tops or shoulders, which limit the movement and thereby prevent detachment of the sliding tongue; and in making the hook separate from the frame, and hinging them together, whereby the buckle is less liable to chafe the animal; and whereby certain other advantages are attained.

Mr. James W. Sheetz, of Woodstock, Va., has patented an improved combined Washer and Wringer, by which the clothes may be cleaned in a superior manner, as the machine admits the effective cleansing of the dirtier parts without rubbing the cleaner ones. The clothes, after being cleaned, are also wrung out.

Mr. James H. Hawes, of Monroeton, Penn., has patented an improved Toy Box. The object of this invention is to furnish a toy box into which may be packed any desired articles or toys for children.

An improved Scarf Fastening has been patented by Mr. Henry Sandner, of Hoboken, N. J. It is intended to furnish for scarfs of all kinds an improved fastening device, through which one end of the neck-band may be readily passed, and then firmly retained when in proper position.

Messrs. John M. Taylor and John Mackay, of Fredericton, New Brunswick, Canada, have patented an improved Rein Holding Attachment for Harnesses, which is constructed so as to receive and support the reins should they be slacked by the driver, and to hold them should they be laid down for a few minutes by the driver, so that they will not catch upon other parts of the harness.

Mr. James B. Brown, of Suisun City, California, has patented an improved Book Holder, for holding music in position on the rack of a piano, organ, or other instrument. It is readily applied to the sheets or book of music, and lifted therefrom to admit of turning, being also applicable for the purpose of holding a book or papers in open position on the desk or rest, for reading, writing, etc.

An improved Coffee Pot has been patented by Mr. Armstrong B. Place, of Denver, Col. This invention consists in a novel construction of a vessel for holding the ground coffee and straining the liquid. It may be used in connection with a pot or boiler of any suitable description; but its efficiency is enhanced when used in a vessel to which it is adapted.

Messrs. Frederick A. Copeland and Robert W. Taylor, of La Crosse, Wis., have patented an improved Fire Escape, of that class in which a carriage or traveling frame is sustained upon a rail fixed near the roof of the building. The chief features of novelty consist in means for propelling the carriage (from below) to a position upon the rail in front of any particular window or door, and in means for regulating and rendering uniform the descent of persons on an endless rope depending from the carriage, an automatic governor and separate friction brake being employed for this purpose.

Mr. Samuel P. Halleck, of Oriskany, N. Y., has patented an improved Feed Gauge, by which the pin holes in the blanket are done away with, and the end and side gauges readily adjusted to the paper to be printed on the press.

Mr. Ansel D. Jones, of Kirksville, Ky., has invented an improved Riding Saddle, which is formed in two separate parts, the seat piece being secured detachably to the bow and bars by bolts. The principal advantage gained is great economy of labor and material in construction.

An improved Leather Whip has been patented by Edward B. Light, of Denver, Col. The object of this invention is to furnish an improved leather whip of perfect taper and bend, and of such elasticity and cheapness as to be durable and very serviceable.

Christoph Weeke, of St. Charles, Mo., is the inventor of an improved Heater that is to be used in connection with a stove for the purpose of heating the same room by the heat that would otherwise pass off through the chimney, or for the purpose of heating upper rooms, the entire heater being either set entirely into the wall or partly into the wall and partly projecting into the room.

Perceval Moses Parsons, of Melbourne House, Black Heath, Kent county, England, has patented an improvement in the Manufacture of Copper Alloys containing manganese, which consists in adding to the copper alloys a proportion of spiegeleisen, ferro-manganese, or other carburet of iron combined with a sufficient quantity of manganese.

Mr. John Prosser, of Ottumwa, Iowa, has patented an improved process for Extracting Metals from their Ores, which consists in combining the ores (containing gold, silver, and copper) with a flux composed of sulphate of iron, salt, black oxide of manganese, and saltpeter, then

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subjecting them in closed retorts to a dull red heat without access of air, to chloridize the metals, and finally washing out the metal chlorides.

An improved Lathe for turning Masts and Spars has been patented by Henry Kean, of East Boston, Mass. This is a ponderous machine which is capable of taking a log and converting it, in a comparatively short space of time, into a smooth, well-rounded mast or spar. The lathe cannot be properly described without engravings.

Mr. Benson Lent, of Peekskill, N. Y., is the inventor of an improved Blind Hinge, which will be locked automatically when the blind is closed or fully open, and will retain the blind, also, in other positions, and will prevent the removal of the blind from its hinge pin, except when the blind is fully closed or fully open.

Mr. Patrick T. Weir, of New York city, has patented an improved Measuring Attachment for Refrigerating Milk Wagons. The object of this invention is to furnish, for the purpose of delivering milk in cities, improved measures for a refrigerating milk wagon. The measuring vessel serves to measure the milk as it is transferred to the tank, and there is a device for measuring the milk as it is taken from the tank.

Mr. Samuel M. Palmer, of Glens Falls, N. Y., has patented an improved Horse Collar for draught horses. It consists in a hollow perforated metallic pad, and in a device for forcing air through the perforations of the said pad.

Mr. John J. Brady, of Long Island City, N. Y., has patented an improved Step Ladder, which is of novel construction, and is provided with a peculiar hinge for connecting the rear brace with the ladder. By using this hinge the various sorts of stays that have heretofore been employed in preventing the rear braces from slipping backward may be dispensed with, as the hinge limits rearward movement of the braces.

Mr. Alonzo Templeton, of Louisville, Ky., has invented an improved Clamp for Securing Corks in Bottles. It may be readily applied to the neck of a bottle, so as to hold the cork firmly in place while the contents are going through the heating process, and as readily removed in order to allow the cork to be withdrawn.

Mr. Rudolph Loth, of Bridgeport, Conn., has patented an improved Blind Slat Adjuster, for setting slats of shutters and blinds in any desired position, and retaining them rigidly, without the annoying rattling or changing of the position of the same, and without giving a chance to turn the slats from the outside.

Samuel Strauss, of Charleston, West Virginia, has patented an improved Barrel for Shipping Bottled Liquors, and especially bottled beer, in such a manner that the packages may be handled with greater facility than the boxes in which such bottles are shipped at present, and that, furthermore, the bottles may be so packed as to be perfectly safe, and not exposed to the danger of getting injured or broken, the bottles being so supported in the barrel that there is a very small weight on any part of the same. The barrel may be securely locked, and the bottles arranged therein so that every bottle is separated from the remaining bottles, and may be taken out without disturbing the rest. The barrel is also of great advantage for reshipping and returning the empty bottles, and as every bottle can be taken out with great facility, it prevents the reshipping or losing of full bottles, which occurs when the same are packed with straw.

Samuel C. Smith, of Norristown, Pa., has devised an improved Hose Clamp, by which the leaks that frequently occur in the hose during fires may be stopped quickly and reliably, so as to save the time required for changing that section of the hose and prevent the delay incidental thereto.

Samuel Maneer, of Craigvale, Ont., Canada, has invented an improved Pole Tip for attachment to the tongues of vehicles for connecting the neck yoke with the tongue, which may be adjusted outward or inward upon the tongue, according as longer or shorter horses are to be used.

An improved Balloon has been patented by Mr. James Tracy, of Waltham, Mass. The object of this invention is to so improve the construction of balloons as to enable an aeronaut to vary the capacity and buoyancy of his balloon for sustaining it at any desired altitude, and for ascending or descending, without the use of hydrogen or other gas for the purpose, simply by varying the space of vacuum.

Mr. Simon L. Pollock, of St. Paul, Minn., has patented an improved Fireproof Shutter, formed of an interior and an exterior sheet iron wall, separated from a central partition wall by metallic cross strips, and joined at the edges by flanges to form closed chambers for inclosing air without admitting its circulation.

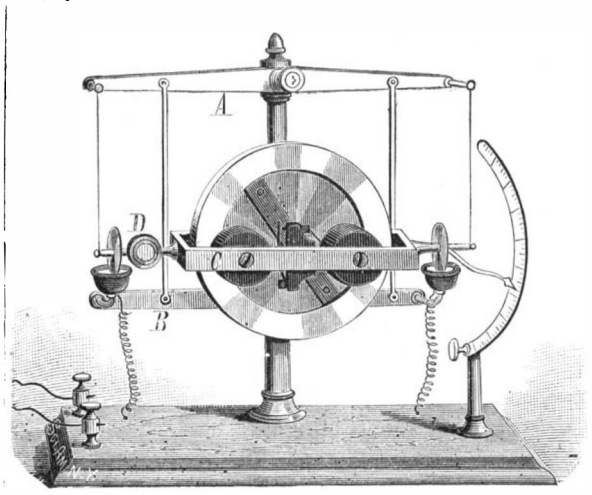
ELECTRICAL INDICATOR FOR SHOWING THE ROTATION OF THE EARTH.

BY GEO. M. HOPKINS.

In my article on this subject in No. 1 of the current volume, a form of instrument is shown in which the index is placed in a horizontal plane, and would indicate an hourly motion of 15° at the poles, while at the equator it would not indicate at all.

In the accompanying engraving an instrument is shown which is suspended with the axis of the wheel supporting frame, C, at right angles to the plane of the equator and parallel with the polar axis of the earth. The frame, C, is suspended by silk threads from studs that project from the beam A. Two vulcanite mercury cups are supported by the beam B in position to make an electrical connection with the disks on the axes of the frame, C. These cups are connected by a spirally coiled wire with the binding posts that receive the battery wires. The beams, A, B, are connected by rods, so that when it is desired to adjust the instrument the parts will maintain their proper relation.

Upon one of the axes of the frame, C, there is an index that moves in front of the scale of degrees. Upon the other axis there is a small mirror, D, for receiving a beam of light and projecting it on a screen. By this arrangement a very long index is secured without additional weight or momentum. For this suggestion I am indebted to Professor A. M. Mayer, who also suggested in his communication in No. 3 of current volume the suspension of the instrument by silk fibers.

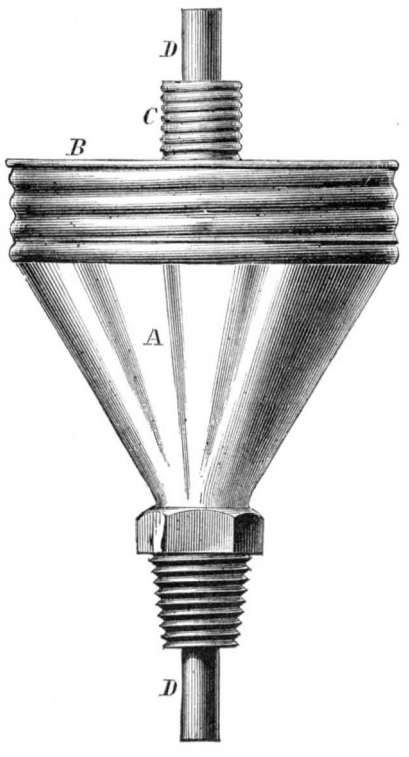


The instrument shown in the engraving should, when the axis of the frame, C, is adjusted equatorially, indicate 15° motion per hour in any latitude. The possible application of this instrument in a larger form to equatorial telescopes in place of the present clock trams, suggests itself. The only difficulty, if any, would be in providing telescope mountings of sufficient delicacy.

The arrangement of the wheel, the commutator and connections is substantially the same in this instrument as in the one previously described.

TIN SHAFTING CUP.

Our attention has been called to above cup as a simple yet effective device for conducting grease to the bearing for the purpose of lubricating in place of oil. We say simple because it works automatically and requires very little care compared to oil cups; and that it is effective and economical is demonstrated by the fact that it feeds only as lubrication is required, and thus all the lubricant is utilized, one pound of the grease doing as much work as two gallons of oil. It was supposed that when cups were invented to feed oil to the bearing as required, we had reached perfection in lubricating, but by the use of grease a coating is formed on the bearing which remains to do the work.



The question now is as to the best grease and cup. In 1875, the judges at the American Institute, New York, gave to Professor Thurston, who is authority on lubricants, five samples of oils and greases, to be tested as regards their lubricating qualities. They were marked A, B, C, D, E. After some three thousand tests made carefully and thoroughly, occupying three months to make, the result was given to the judges that the grease marked D was ahead of all competitors as a lubricant. And on this report the silver medal of the American Institute was awarded to R. J. Chard, 134 Maiden Lane, New York, whose patent lubricene was represented by letter D.

The report of the judges at Philadelphia on his patent cup, of which we give an engraving, was that it is the best friction feeding cup.

The engine that furnishes the power to machinery in American department at the Paris Exhibition is fitted up with patent lubricene and cups. The engraving needs but little explanation. D, the feeder, passes through the body of the cup, A, with its cover, B, and also the screw cap, C. This cap, fitting over the spring of the feeder, is movable, and can be adjusted to regulate the feed by the pressure given to the spring. This principle of feeding lubrication to the bearing is the only true automatic and economical principle. The cost of lubricating is thereby reduced to its minimum. This cup is adapted to ordinary shafting, and is very effective, and can be set and will work at any angle.

THE MUSICAL MECHANISM OF THE CINCINNATI ORGAN.

We recently referred to the large organ lately erected in the new Music Hall at Cincinnati as being among the largest pipe organs in the world, certainly the largest ever made in this country. It comprises five different organs, namely, the great organ, the swell organ, the choir organ, the solo organ, the pedal organ; these may be played separately or in combination. There are four key-boards, each composed of 61 notes (from C_0 to C_4), five octaves long, and each controls the valves that admit the compressed air to the pipes belonging to its particular organ, or division of the whole organ. Just above the great organ key-board are placed five white thumb knobs, and a smaller black one near each, while between each pair is a tablet showing its use. These thumb knobs control the couplers by which the various key-boards are connected to the great organ key-board, so that either may be played from it without removing the hands. Under the manual key-board there is the pedal key-board, which has a compass of 30 notes (from C to F_0), two and a half octaves. Here there are the white and black keys, the same as on the manual key-boards, only made of wood instead of ivory, and larger, as they must be played with the feet. This key-board opens the valves to the pipes of the pedal organ, which includes the immense thirty-two foot open diapason pipes.

Just above the pedal organ key-board lies the crescendo pedal, a slide having frequent projections against which the feet are pressed in operating it. Above this, again, there is a row of combination pedals, ten in number, and in the center the swell pedal, which is so nicely balanced and adjusted that a very slight movement of the toe or heel causes it to act, and yet it remains exactly where it is left. To the right and left of the manual key-board are terraces of knobs, angled so as to front the organist, and all within easy reach. The organ, therefore, has four manuals or key-boards of five octaves each, and a pedal key-board of two and a half octaves. The great organ has 22 complete registers, 228 pipes. The swell organ has 19 complete registers, 1,708 pipes. The choir organ has 17 complete registers, 1,281 pipes. The solo organ has 7 registers, 366 pipes, and 32 bells. The pedal organ has 16 complete registers, 600 pipes. There are 15 mechanical registers, and 14 pedal movements. A summary of these gives 96 registers, 6,237 pipes, 32 bells, 14 pedal movements.

In the cellar under the organ is the foundation upon which the organ stands. Large brick columns, placed closely together, reach from below the surface to the heavy capping timbers on which the floor timbers ar laid. These are covered with two thicknesses of flooring, the upper one of which is of two inch pine, the whole forming a support that will sustain the immense weight of the instrument without the slightest deflection.

Five motors are employed to operate the five bellows in the organ. To supply these motors, a six inch pipe is led into the cellar from the street main, branches from which convey the water, having a pressure of 52 pounds per square inch, to the motor. Each branch has its shut-off and regulating valves independent of the other; so that in case anything should happen to either, the others can be worked. Here also are the levers for hand blowing, so that, should the water pressure fail at any time, man power can be substituted.

The bellows consists of two parts—the feeders and the reservoir. The feeders of these bellows are known as square feeders, in distinction from those usually employed, where they are hinged on one side, called diagonal feeders. Those here are one half the size of the bellows each, and arranged so that as one is going up the other is coming down. As one drops down, the valves in the bottom open, allowing it to fill with air, which close as soon as the motion changes. The air is then compressed until it raises the valves between the feeder and the reservoir, allowing the air to pass into and inflate the reservoir. To obtain the necessary wind pressure, weight is placed upon the top of the reservoir, and in the aggregate about 5,000 pounds is used for this purpose. Beyond the bellows, on either side, are the lower pipes of the 32 foot open diapason, those seen on each wing of the organ from the hall. By placing a rule on the lower C, it is found to be 24 inches in width by 30 inches in depth, with a mouth seemingly large enough to require a bellows of its own to furnish a supply of wind for it.

Back in the rear, against the wall, are the pipes of the contra-bombard, 32 feet. On examination of the lower note of this register it is seen that the tone is made by the vibration of a piece of brass, called a "reed," 13½ inches long, 1¼ inch wide, and $\frac{3}{16}$ inch thick. It vibrates very slowly, but with such an effect as to be heard even when all other registers are used. The work of construction was begun by the builders, Messrs. E. & G. G. Hook & Hastings, of Boston, Mass., in May, 1877.

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FIRST IMPRESSIONS OF THE ECLIPSE OBSERVATIONS.

It is of course too early to expect any strictly scientific or conclusive estimate of the bearing of the eclipse observations on current solar theories, there having been no opportunity for a critical study and comparison of the photographs and other records obtained. Yet the impressions made upon the observing astronomers by the more striking phenomena are not without interest. How far the dissimilarity of the results from those obtained at previous eclipses is to be attributed to the markedly quiescent condition of the sun's atmosphere at this time, how far to the circumstance that most of the observations were made through the thin clear air of high Rocky Mountain regions, and how far to hitherto unsuspected changes going on in the sun, remain for solar experts and future observations to determine.

As regards the constitution of the corona, the results, Dr. Draper says, were entirely unexpected. Owing to the absence of great eruptions on the sun, that observer concludes that a true or normal spectrum of the corona was obtained for the first time. Consequently the luminous gases formerly discovered therein, particularly that giving the bright green line 1474, must have been temporary or accidental and not essential elements of the corona. His spectrum photographs showed that the light of the corona was derived solely by reflection from the sun. Prof. Barker's analyzing spectroscope bore the same testimony, as likewise did Prof. Morton's observations with the polariscope.

Touching the effect of the varying constitution of the corona, Dr. Draper said to the *Herald* correspondent:

"It is rather singular while the sun has been in such a quiescent condition for more than two years that we have not seen more changes in the climate of the earth. This would seem to show that the abnormal condition of the sun at the maximum period of sun spots, which occurs every eleven years, counts for but little against the total amount of heat that is sent out from the sun at all times. The present observations go to show that the activity or quiescence of the sun makes no perceptible difference in the earth's condition. I do not regard this most marked change in the corona as portending any change in the condition of either climate or crops."

Mr. Norman Lockyer interprets the evidence very differently. He says: "The present eclipse has accomplished, if nothing else, the excellent result of intensifying our knowl edge concerning the running down of the solar energy. With the reduction of the number of spots or prominences for the last four years, the terrestrial magnetism has been less energetic than it has been for the preceding forty years. This would evidently account for it, as well as for the great famines in India and China which took place forty-four years ago. The sun is the great prime mover of earth. Every cloud, every tide, every air current depends upon it. Its present quiet condition indicates great heat on earth. When in a state of activity the sun throws out an atmosphere which serves as a shield to the earth, protecting it from abnormal influences of the sun. The absence of the green lines shows a great reduction in the temperature of the sun, and such a marked change in the sun should produce a corresponding change on the earth. A continuation of this changing of the sun's condition must inevitably be followed by serious results and radical climatic variations."

President Morton says that the marked changes in the sun's condition would seem to call for corresponding marked changes in the condition of the earth, and it is a surprise that no such changes have occurred.

He is of opinion, however, that the evidence tends to sustain the theory that the sun's heat is maintained by the impact of meteoric matter, which is known to vary largely in constitution, and it is possible that the sun's fires may be fed at times with purely mineral matter, and again for considerable periods with meteorites highly charged with hydrogen, giving the sun a far-reaching atmosphere of the ignited gas. "If such changes go on indefinitely it may not be irrational to inquire whether they may not in future produce such extraordinary climatic conditions in the earth as geology teaches us have existed in the ages of the past, or, in other words, the polar regions become tropical, as the fossil remains of animals and plants found there indicate they have been."

Mr. Cowper Ranyard, while recognizing the marked changes in the sun's atmosphere, does not anticipate any great effect from them on that of the earth. Prof. Young agrees with Dr. Draper and the rest in thinking that Mr. Lockyer exaggerates the effect of coronal changes upon the earth's climate. So apparently does Prof. Newcomb, who does not expect from the results obtained any upsetting of well-founded current theories or the establishing of any strongly based new ones.

Lockyer's Report of the Eclipse of July 29, 1878.

The English astronomer, J. Norman Lockyer, sums up the results of the eclipse observations, in a dispatch to the London *Daily News*, as follows:

"The eclipse has been most satisfactorily observed at all the Northern stations, and at all the Southern ones from which news has been received up to the present time. The corona was markedly different from those observed in 1869, 1870, and 1871, and this year's observations have demonstrated the great variation in the structure and condition of the sun's outer atmosphere, when there are most and fewest spots on his disk. The corona was small, of a pearly luster, and the indications of definite structure were limited to two portions. Several long rays were seen, and Newcomb, who had erected a screen on a high pole, thinks he detected the zodiacal light extending 6 degrees from the sun. Draper, who used a Rutherfurd grating two inches square, and a camera of large aperture, and Lockyer, who placed a small grating in front of an ordinary portrait camera, both obtained photographs of the spectrum of the corona. A continuous spectrum only was recorded, and in ordinary spectroscopes the bright lines usually seen were altogether absent. Lockyer, who observed with a simple grating, saw no rings. All these are so many indications of a wonderful change since 1871, and there is great probability that the substance which gives rise to the continuous spectrum is not that which produces any of the lines. Newcomb's party and Barker made careful search for dark lines in the corona, but none were observed. Young has telegraphed that there were no lines observed in the ultra violet at Denver. It would appear, therefore, that he also has obtained photographic evidence of a continuous spectrum. The radial polarization observed in 1871 has been confirmed by Holden. A new use of the eclipse has been introduced on this occasion. Newcomb, Watson, Holden, and others have included a search for intra-Mercurial planets in their programme, and Watson has been fortunate enough to detect a body of four and a half magnitude near the sun, which is certainly neither a known star nor a planet.

"Every facility has been afforded to the astronomers, and a fourth station along the northern line crossing the belt of totality was at the last moment organized by the Union Pacific, a traveling photographic car being run to a point between the eclipse camps at Separation and Creston. The tasimeter, the new instrument on which Edison has been working unceasingly here, has proved its delicacy. During the eclipse he attached it to Thomson's galvanometer, which was set to zero. When the telescope carrying the tasimeter was pointed several degrees from the sun, the point of light rapidly left the scale as the corona was brought upon the fine slit by which the tasimeter itself was protected. There was no chromosphere to speak of, and only one prominence, like the horn obscured in 1868, but very dim."

Ink Printing from Glass Negatives.

To make negatives capable of being printed from they must be coated with a solution of chromatized gelatine, but only after they are perfectly dry. By this means a layer of chromatized gelatine is deposited over the collodion film. But it is well known that when such negatives are exposed in diffused light the lines become broader than they should be, because the light, even with thin films, can act sideways. In order to obviate this I tried to form a film of chromatized gelatine in that of the collodion negative, and I was fortunate enough to be completely successful. The method that I adopted was to fix the negative immediately it was taken, without first drying, then to wash it with water, and while still wet to immerse it in a dilute solution of chromatized gelatine. When dry, the surface was quite dull, without any sign of gelatine upon it; the collodion film had, notwithstanding, absorbed sufficient chromate and gelatine to be capable of printing from after exposure.

The best method of obtaining these plates with what may be called a typographical collodion film is as follows: First take an ordinary but not an intense negative on an albumenized plate glass plate, fix it at once, wash it, and then plunge it into the gelatine solution, which should be prepared in the following way: 4 to 5 parts of gelatine are allowed to soak and swell up in water, the excess of fluid is poured off, and the remaining gelatine dissolved in 50 parts of distilled water; then a solution of 5 to 5 parts of ammonium bichromate in 100 parts of water are added, and the whole is heated to 75° C. In this bath the plate must remain for about five minutes. When large plates are used, the solution may be flowed over them, taking care to wash them rapidly with warm water beforehand. In this case too it is necessary to repeat the coating with chromatized gelatine several times. After the plate has taken up a sufficient quantity of the solution it is placed in a horizontal position and heated over a spirit lamp. Should fumes come off, the plate must be held upright for a minute or two, and again laid horizontal, and further heated until it is quite dry. It should not be made hotter than the hand can bear when passed over the reverse side.

For negatives of this kind the time of exposure cannot be accurately determined by the eye, nor can it be measured by the ordinary photometer. I overcame this difficulty by first well wiping the prepared negative on the reverse side, and then laying on the film side a small piece of albumenized or chromatized paper, exposing the whole in a frame on the reverse side to the light. By aid of this simple expedient the action of the rays of light can easily be watched, so that places which are too dark can be covered, and all the other articles used which are common in silver printing. Commonly a black support is employed to avoid the reflection of light, but in this process, as I have described it, reflection need not be feared, notwithstanding the white albumenized paper, for the silver chloride absorbs all the rays of light.

As soon as all the finest lines of the image are distinctly visible, the ammonium chromate must be washed out by dipping the plate into cold water; the plate can then be dried, and placed in the hands of the printer. The finest rollers must be used for printing. When the plate is damped I would recommend that a little gum arabic be dabbed on the edge, and rubbed over the surface of the picture. As regards the production of the negative, I should observe that it is not every collodion which will take up the chromatized gelatine; there are collodions which will not absorb the gelatine at all, so that a layer of chromatized gelatine merely is obtained on that of the collodion. The lithium collodion, prepared by Kurz, of Wernigerode, is best adapted for this purpose. Probably the lithium salt in this collodion plays no unimportant part in the reaction, but I have not had an opportunity of making experiments on this point.—*Hans Brand, in Photographische Correspondenz.*

Objections to Helmholtz's Theory of Vision.

The majority of the physiologists of the present day share the opinion of Helmholtz, who explains the possibility of seeing at different distances by changes of form in the crystalline lens; the latter becoming more convex when near objects are looked at, and on the contrary flattening when those at a distance are regarded. M. Fano, in the current number of *Les Mondes*, opposes some very grave objections to this theory; among these, the following:

1. It is possible for certain persons who have been operated upon for cataract by extraction, to see near and far with the same pair of spectacles; that is, with glasses of short focus.
2. The crystalline lens is too dense to allow of its readily taking such modifications of form.
3. The weakness of the muscular organ (ciliary muscle), which is regarded as the agent designed for producing such modifications in the lens.
4. The excessive fatigue to the eye which would result from these incessant contractions of a very weak muscular apparatus, should the lens really change form, from morning till evening, during the exercise of vision on near and distant objects.

"Is it absolutely necessary," he asks, "that changes of form in the refracting apparatus of the eye should take place in order to see near and distant objects clearly? If the eye were a simple optical instrument, it would be necessary to answer this question in the affirmative. But the eye differs from an ordinary optical instrument in this, that the screen of the camera obscura (which the organ resembles as a whole) is not an inert membrane, but on the contrary an organized living one—the retina. Now the existence of such a screen as this must modify, not the mode of formation upon it of the image of exterior objects, according to the distance at which such objects are placed in relation to the eye, but rather the conditions of impression and sensation of these images.

"In effect it is not indispensable in order to see objects that their image should be sharply defined on the retina; that is, that all the luminous rays coming from the same point of the object should unite at a common focus in the retinal layer of rods and cones. Vision still takes place, the eye sees, even when this focus is formed behind or in front of the rod and cone layer of the retina; that is to say, when circles of diffusion are formed on this layer. A very simple experiment will serve to demonstrate this fact: Place a printed page for reading at a distance of 12 inches from the eye; now gradually bring it nearer the eye of the subject, and the latter will still be able to read up to a certain distance, although the printed characters are surrounded by a halo, thus indicating that the image of these characters is forming on the retina a circle of diffusion, and not a sharp image.

"So in order to see it is not necessary that the image of exterior objects should have its focus on the retinal layer of rods. But in this case the impression is less active, because all the luminous rays from the same point of the object unite in less numbers upon the same cone of the retina. If, then, the impression is less active, the sensation is also less powerful and vision is less clear."

The Famine in Northern China.

The horrors of the Chinese famine are impossible to describe, and happily inconceivable to American minds. At a recent meeting in Dublin, Sir Thomas Wade, British Minister to China, said that five provinces, covering an area of 395,000 square miles, with a population of over 120,000,000 (three times that of all the United States), have been so stricken with drought that the ordinary sources of food have been almost entirely dried up, reducing to a state of starvation not less than 15,000,000 people. Not long since the *Christian Union* published a letter from China, in which it was stated, on the authority of the Governor of Shansi, that the number already starved and frozen was estimated at 6,000,000. Whole villages had been depopulated: dogs and fowls and every living thing but crows and carrion birds were dead. "The London estimate that 70,000,000 have perished is no exaggeration, but those actually waiting for death by starvation, more or less prompt, are still 10,000,000 perhaps, of whom relief will be too tardy to save perhaps 2,000,000; while, if the rains are denied in Shansi, Honan, and Shensi again this spring, nothing but foreign or Divine interposition will save 10,000,000 people from death."

Substantially the same testimony is borne by a gentleman holding an official position in Peking, in a letter to the Boston *Journal*. The sale of children and kindred for food has been going on for some time, and cannibalism has been largely resorted to. Had the drought occurred in Southern China there would be less difficulty in relieving the famine, owing to the abundance of water communication. In the north, however, there are no such means for meeting the emergency, there being only earth roads, and those indifferent.

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THE LECHNER MINING MACHINE.

A large number of manufacturers, and a still larger number of householders, are totally ignorant of the great amount of handling to which coal is subject before it reaches their furnaces or fireplaces, and especially of the very onerous labor in "getting" it—that is, to detach it from the body of solid coal, as found at varying depths below the surface of our earth. The heaviest operation in the getting of the coal is to undercut it, which the miner usually has to do with his pick, and in a stooping and frequently very cramped position. The amount of coal which is wasted, or, more correctly speaking, which is made into small pieces or dust, where undercutting is done by hand, is necessarily large, on account of the space required for the pick and the hands and arms of the miner. Because of this waste, and the expense of undercutting, as well as for humanitarian reasons, we are always pleased at seeing earnest attempts made to supersede this operation in coal mining by machinery. The latest form of machine brought out for this purpose is the invention of Mr. F. C. Lechner, and is shown by the accompanying engravings, Fig. 2 giving the machine in position for beginning operations, and Fig. 1 as having already undercut the coal close to the substratum of fireclay, and to the full depth to which the machine is capable of working.

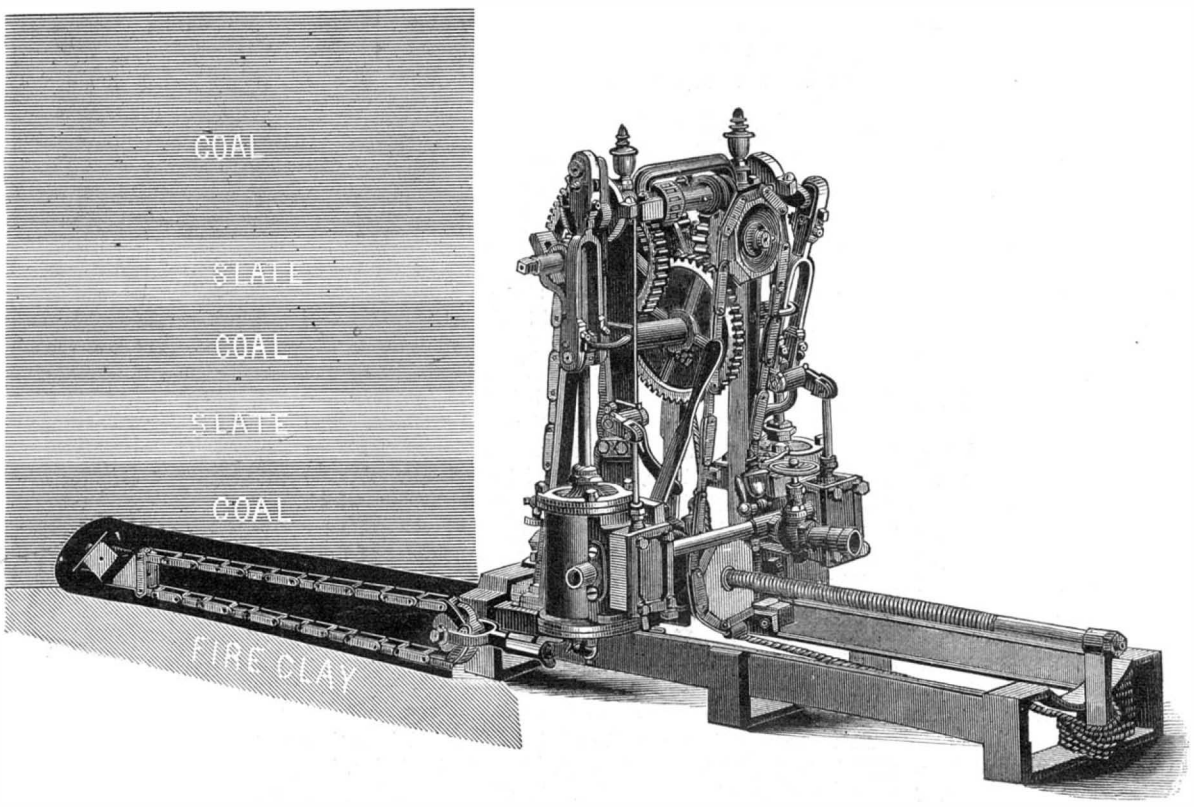

Fig. 1.—THE LECHNER MINING MACHINE.

The essential features of this machine are the cutter bar and the modes of driving it; for whereas, in most mining machines hitherto brought out, the cutter or cutters have been driven in a horizontal plane, the cutters in this case revolve in a vertical plane. The form of the axle is square, as shown, and to it are bolted the cutters, resembling in this respect very much the axles used in wood-cutting machinery. At two places upon the axle the narrow journals are formed, and are laid in suitable brass bearings in ends of the wrought iron framing to which the driving machinery is fixed. Motion is communicated to the axle by a couple of pitch chains, which not only drive by contact with the axle itself, but also by engaging a set of narrow cutters, which enter the open portions of the chain. In this manner only thin films of coal are left uncut where the chains work, and get broken off quite imperceptibly by coming in contact with the links of the chain. By keeping the bearings of the cutter bar as narrow as practicable, and arranging the cutters close to the framing, also the very little coal left uncut here gets similarly broken off by the advancing framing. The dust produced in cutting is carried away partially by the two driving chains already mentioned, and partly by another set of chains working at the two sides of the machine, as shown.

In addition to the wrought iron bars, which, as we have explained, form the framing to which the cutter bar and the driving gear are attached, another set of similar bars at the side of them form the stationary framing on which the whole machine slides. The forward motion is given by means of a stationary screw, round which a nut revolves, and this motion is arrested by moving a handle which separates the two halves of the nut in a similar way as the screw and nut are disconnected in most screw-cutting lathes. To bring the machine back again a bolt, attached to the stationary framing, is, by means of a handle, thrown into gear with one of the pitch chains, which are kept revolving to clear away the dust—although at a much slower pace than when the cutting takes place. Suitable means are provided for taking up the slack of the pitch chains when underwear takes place, but this is minimized by making them, as well as many other parts of the machine, of steel. Either steam or compressed air can be used for driving, but the means by which the motion is communicated from the pair of cylinders to the pitch chains and to the feed nut possess no especial interest, and we need, therefore, not describe them. The machine only weighs 750 lbs. complete, and can be handled by two men, so that it is unnecessary to lay down rails for it. It can either drive an entry, work in pockets, or on the long wall system. The over-all dimensions are 7 feet 6 inches long, 3 feet wide, and 2 feet 3 inches high, and the cut which it makes is 6 feet deep and 3 feet wide, and only 4 inches high, so that but little coal is wasted as compared with that lost in consequence of hand-cutting. It is stated that only six to eight minutes are required to make a cut of the above dimensions, and as but little time is found to be needed for shifting and refixing the machine, the saving effected by it should be considerable—over 60 per cent., we are informed. The agents in this country are Messrs. Frank Wheeler & Co., who are exhibiting one of these machines in the American section of the Paris Exhibition. We shall watch with interest the trials of it in the mines of this country.—*Iron.*

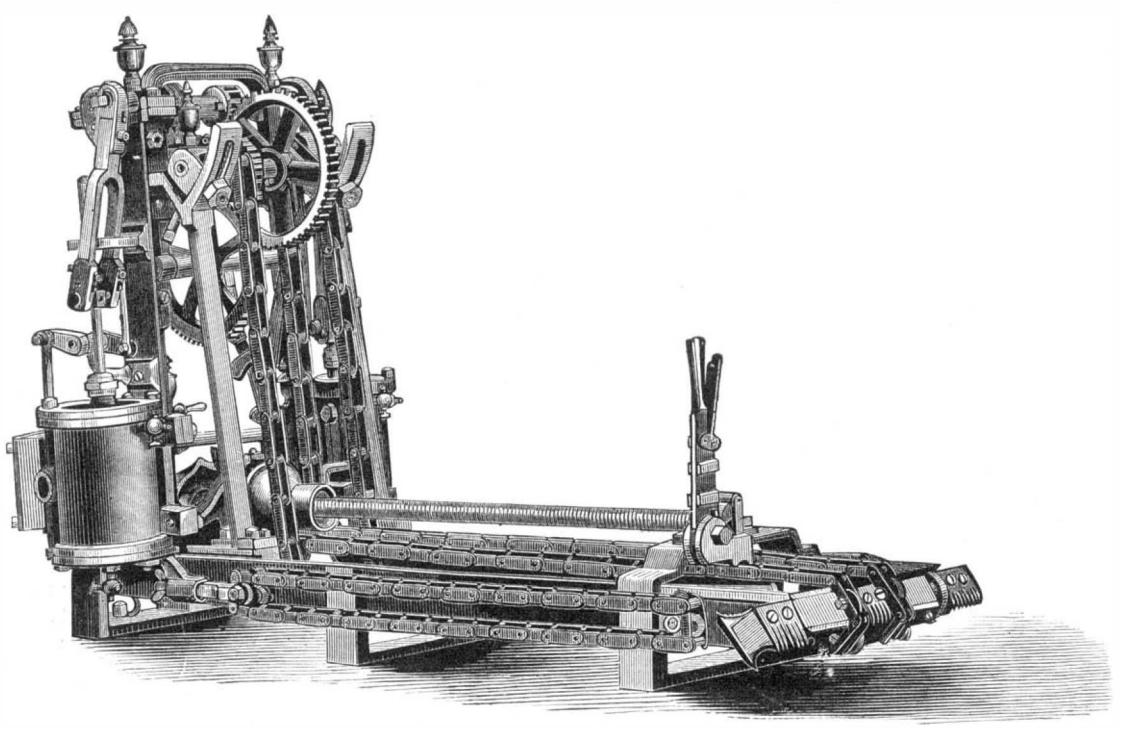

Fig. 2.—THE LECHNER MINING MACHINE.

Walking Under Water.

Mr. Robert J. Russell, a professional diver of this city, has proved his ability to walk long distances under water by a walk of eight miles on a submerged track, one sixth of a mile in length, at Riker's Island, near Hell Gate. Clad in the regular diver's dress, weighing 200 pounds, he lately walked the prescribed distance in 4 hours 37 minutes. The times for the successive miles were 35, 30, 47, 45, 30, 29, 31, and 30 minutes respectively.

THE seed farms of Messrs. Webb at Kinver, Stourbridge, England, were lately visited by the Midland Farmers' Club, on the invitation of the proprietors, who received the party with unstinted hospitality. They are the largest seed farms in the kingdom, being altogether 1,100 acres in extent.

The Industrial Prospect.

In a discussion of the brighter industrial and financial outlook, the *Tribune*, after noting the evidence of a larger contribution to the nation's wealth from agriculture this year than ever before, goes on to remark that "there are many indications that manufacturing establishments, in spite of low prices of products, are doing a large business with gradual improvement. We must remember, first, that many of the most important branches of manufacture have been going forward with undiminished volume during all these years of disaster. The milling interest is one of the first importance, but there has been no decrease in the quantity of flour made, and improvements in machinery have enabled the country to produce a better article at less cost than ever before. The lumber interest, and the many branches of manufacture which depend upon it, have been steadily growing. In the manufactures of leather, though the exports of boots and shoes formerly made have not yet been recovered, there has been a great improvement in quality and in price, and a consequent expansion of the domestic demand. American spinners are making but slender profits, and yet they are consuming great quantities of cotton, and have begun to recover the foreign markets lost during the war. The well known fact that American cotton goods at last find a regular and considerable sale in England will finally yield important results as to the supply of other markets. Probably there has never been a time when the people of this country were so largely supplied with woolen goods by American mills, or so cheaply supplied, and their independence of foreign industry in this regard, when once established, will bring, in better times, the handsome profits which few woolen mills have recently been able to realize.

"Depression in the iron and coal business has attracted much attention, because of the great importance of that interest. But it is well to observe that this depression has been largely due to a change in the quantity of steel employed. The later processes, permitting the production of steel at a cost really less than that of iron years ago, have been followed by a general substitution of steel for iron in many uses. Half a million tons of steel rails not only displace as large a quantity of iron, but, enduring much longer, save a large part of the former expense of relaying and repairs. This proves very trying to the iron manufacturers for a time, and it is probable that there may never be full employment for all the establishments once supposed to be needed in the production of iron; but the country is, nevertheless, saving many millions every year by the use of the more durable metal. In the end, it will be the richer for this great change, though many individuals suffer meanwhile. The best feature in the case is that the American iron and steel manufacture has at last been so developed that it practically excludes foreign products from the home market, and, with a revival of prosperity here, is in position to supply an enormously increased demand on profitable terms."

Water Gas.

PROFESSOR E. FRANKLAND, of the Royal College of Chemistry, London, has written to Mr. Francklyn, of New York, President of the Municipal Gaslight Co., stating that he has read the report of Professor Henry Würtz and Professor Henry Morton, concerning the qualities of water gas made here, and gives it as his (Professor Frankland's) opinion that it may be used with safety in public and private buildings. He would also be highly gratified if similar gas could be introduced in London.

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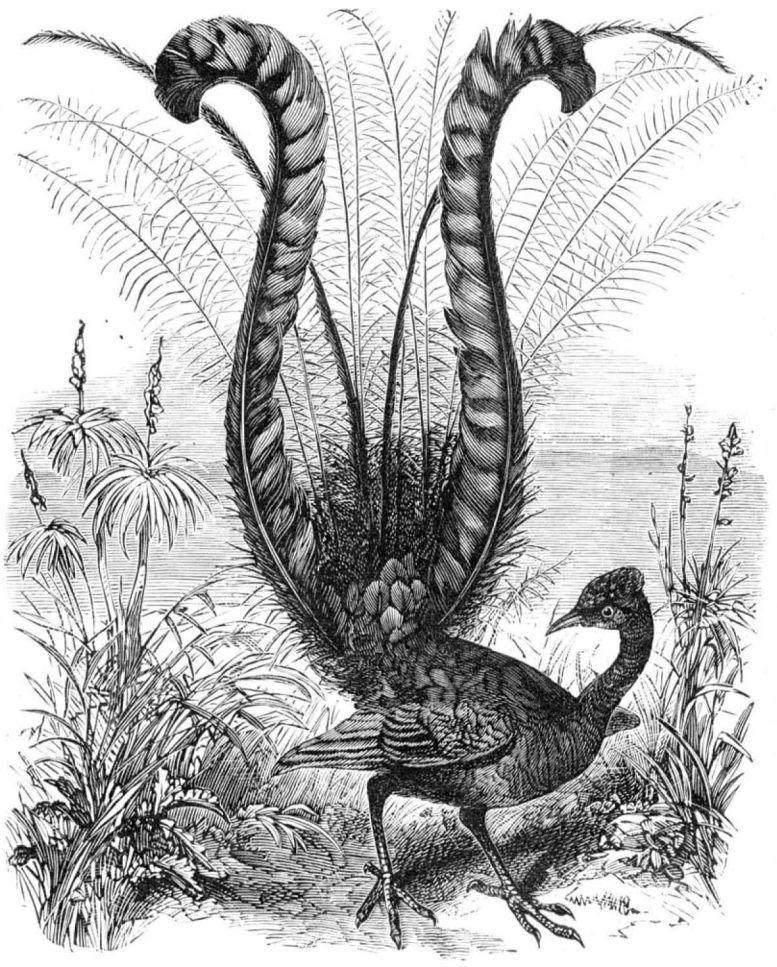
THE LYRE BIRD.

This bird, if it had been known to the ancients, would have been consecrated to Apollo, its lyre-shaped tail and flexible voice giving it a double claim to such honors. The extraordinary tail of this bird is often upward of ten feet in length, and consists of sixteen feathers, formed and arranged in a very curious and graceful manner. The two outer feathers are broadly webbed, and are curved in a manner that gives to the widely spread tail the appearance of an ancient lyre. When the tail is merely held erect, and not spread, the two lyre-shaped feathers cross each other, and produce an entirely different outline. The two central tail feathers are narrowly webbed, and all of the others are modified with long slender shafts, bearded by alternate feathery filaments, and well representing the strings of the lyre.

The tail is seen at its greatest beauty between the months of June and September, after which time it is shed, to make its first reappearance in the ensuing February or March. The great stronghold of the lyre bird is the colony of New South Wales. It is of a wandering disposition, and although it probably keeps to the same bush, it is constantly engaged in traversing it from one end to the other, from the mountain base to the top of the gullies, whose steep and rugged sides present no obstacle to its long legs and powerful muscular thighs. It is stated that it will spring ten feet perpendicularly from the ground. The food of the lyre bird consists principally of insects, particularly of centipedes and cleoptera.

We take our illustration from Wood's "Natural History."



THE LYRE BIRD.

Photographic Maps.

The advantages of the process of sun engraving upon copper, as practiced by the Austrian Military Geographical Institute, are dwelt upon in *Petermann's Mittheilungen.* The maps of the new Austrian ordnance map are carefully drawn on paper, on a scale of 1 to 60,000. They are then reduced photographically to a scale of 1 to 75,000, transferred upon copper, touched up, and printed. In this manner each sheet of the map can b produced in nine months, while the same amount of work, engraved in the usual manner, requires nearly 46 months for its completion. The whole of the Austrian staff map, consisting of 715 sheets, will thus be completed in 10 or 12 years. No less than 271 have been published since 1874. The advantages of this process, as regards cost and rapidity of publication, are evident, and they fully compensate for any slight inferiority in the appearance of the work.

NEW BRIDGE OVER THE DOURO RIVER, PORTUGAL.

The viaduct projected by the Royal Company of Portuguese Railroads, and designed to traverse the Douro River, near Oporto, Portugal, is nearly 1,129 feet in length between the faces of the abutments. The roadway is 200 feet above the plane of general comparison, said plane being 38 feet below the level at low water. A central arch crosses the stream and is connected at the upper portion to the sides of the ravine by two lateral viaducts. The depth of the river and the thickness of the clay banks, which it was necessary to traverse in order to plant piles securely, rendered the adoption of the single arch, 512 feet in span, and supported on the rocks on each side, advisable. On the summit of this arch the roadway rests, while it is also supported by metal trestles which conform in height to the irregularities of the soil.

Owing to the dimensions of the arch its construction involves some peculiar features. It was, in the first place, necessary to avoid the use of rigid tympanums, in which case the calculations, already very uncertain, became still more complicated owing to the dilatation, the effects of which would profoundly disarrange the equilibrium of the various parts. It would also be necessary to use an immense quantity of metal in order to insure the safety of the structure. Tympanums were therefore completely suppressed, the arch being given sufficient rigidity to resist the strains tending to deformation resulting from unequal distribution of the stress. The arch was therefore given considerable vertical thickness, this being 32 feet at the key. At the abutments it was essential that the arch should rest on two supports, as is ordinarily the case on large openings. It thus became necessary that the vertical height should decrease toward the extremities, the extrados and intrados converging on the support. To this end the form adopted is that of an arch of neutral fibers almost parabolic, but the highest of which diminishes from key to abutments. This form is that of a demi-lune—the intrados and extrados being besides interconnected by a system of vertical and oblique pieces forming St. Andrew's crosses, so as to insure the complete solidity of the whole.

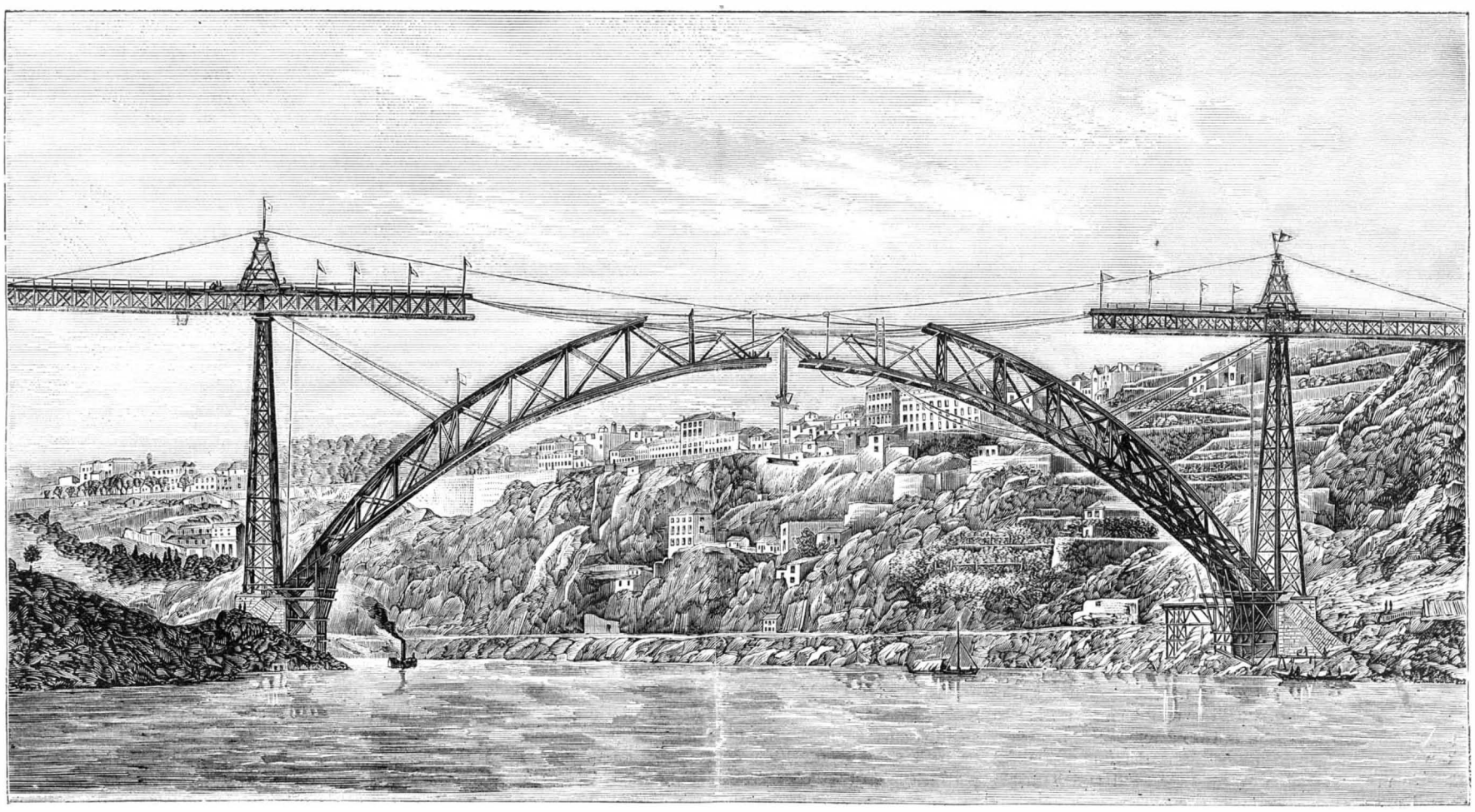
A new condition also presented itself due to the resistance offered by the structure to the wind. In order that the violence of tempests might be resisted, it was indispensable that the arch should be broad or at least possess a wide base, as it was obviously useless to make the upper portion wider than the 12·8 foot roadway. The width of the base supports was therefore fixed at 48 feet—as it was necessary to form the central arch as a crescent situated in oblique planes with relation to the vertical, distant 12·6 feet at the upper portion and 48 feet at the base. The arches are connected by a system of vertical frames, placed transversely, formed by horizontal traverses and vertical rising timbers fixed on the arches and the St. Andrew's crosses. Besides, in the planes of the intrados and extrados are strengthening pieces which consolidate the connection between the two arches.

The roadway reposes on each side on a metallic pillar fixed on the spandrel of the arch, and is prolonged to the abutments resting on the Lisbon side, on a trestle which has its base on the arch abutment, and then on two similar trestles of less height. On the Oporto side there is but one intermediate pillar. The roadway is so attached to the arch that the latter is free to move without disturbing it. The pillars are entirely of laminated iron—cast iron being rejected as not offering sufficient security. We take our illustration from *Engineering.*

American Institute Exhibition.

Our manufacturers are now fully awake in the matter of exhibitions, and so far as their limited space is concerned we are assured the coming exhibition of the American Institute of this city will be of more than usual value and novelty. For information address the General Superintendent, New York city.

CONSUMPTIVE PERCH.—Seth Green has lately been examining the perch and sunfish that have died in great numbers in Lake George. He finds that the disease is a fungous growth on the gills, resembling pulmonary consumption; and warns the people against eating the fish.



THE NEW BRIDGE OVER THE DOURO RIVER, PORTUGAL.

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New Agricultural Inventions.

Emanuel Cook, of Oglethorpe, Ga., is the inventor of an improved Condensing Attachment to cotton gins, by which the cotton is delivered in smooth and uniform state, and clear of all dust, sand, and trash, the latter being conducted to the outside of the ginhouse, so as to prevent it from settling on the cotton and machine.

Joseph Laude, of Monticello, Ark., has patented an improved Seed Planter for planting cotton, corn, peas, and other seeds, which plants the seeds regularly and uniformly, and may be adjusted to plant more or less corn and peas to a hill. It will plant the seed to the end of the row, and will not catch upon stumps or other obstructions.

Alexander G. McIntosh, of Atalissa, Iowa, is the inventor of an improved Binding Harvester, which cuts the grain, gathers it into gavels, and binds it, the various operating parts receiving motion from the drive wheel of the machine.

An improved Gate has been patented by Stephen W. Moore, of Mount Etna, Ind. This invention relates to the construction of the pivot of the lever that operates the gate, the construction of the hinge of the gate, and the device for locking the gate in any vertical adjustment.

Daniel Hays, of Martinsville, Mo., is the inventor of an improved Corn Planter and Plow, whereby the plowing of the ground, cutting of weeds to prevent choking of the plows, and the dropping and covering of the seed are all performed at one operation

Stephen McColm, of Waggoner's Ripple, Ohio, has patented an improved Soil Pulverizer, for breaking in pieces the lumps and clods of soil, to better adapt it for cultivation. It is so constructed as to bring the weight of the machine in contact with the surface of the soil on about one-third of the surface covered by the machine. It will readily clear itself of clods that may be forced into its interior.

An improved Grain Drier has been patented by Richard H. Tiernan, of Galveston, Texas. The invention consists of a sheet metal box having a series of inclined and laterally oscillating sieves, in connection with fixed shelves below the sieves, and with a top supply hopper and a bottom discharge opening for the grain. The box or casing is provided near the bottom with an entrance opening for the blast of hot air, that is forced in opposite direction to the motion of the grain through the apparatus and to the outside by a top opening near the supply hopper.

Alfred N. Myers, of Augusta, Ky., has invented an improved Churn, which is so constructed that by oscillating a lever the dasher arms will be moved rapidly through the milk, first in one direction and then in the other, throwing the milk into violent agitation, and bringing the butter in a very short time.

Isaac Turman, of Smithland, Iowa, has patented an improved Grain Separator for cleaning oats and other grain of the various impurities, such as chaff, dust, dirt, etc., for using it as a better feed for horses in training, or for seeding or other purposes.

The True Idea of Teaching.

Commenting on the failure of Sir John Lubbock's motion to add an elementary knowledge of common things to the subjects of instruction for which grants are given under the English Education Code, the London *Times* remarks that "a large amount of costly and pretentious teaching fails dismally for no other reason than because it is not directed by any knowledge of the mode of action of the organ to which the teacher endeavors to appeal; and mental growth in many instances occurs in spite of teaching rather than on account of it. Education, which might once have been defined as an endeavor to expand the intellect by the introduction of mechanically compressed facts, should now be defined as an endeavor favorably to influence a vital process; and, when so regarded, its direction should manifestly fall somewhat into the hands of those by whom the nature of vital processes has been most completely studied. In other words, it becomes neither more nor less than a branch of applied physiology; and physiologists tell us with regard to it that the common processes of teaching are open to the grave objection that they constantly appeal to the lower centers of nervous function, which govern the memory of and the reaction upon sensations, rather than to those higher ones which are the organs of ratiocination and of volition. Hence a great deal which passes for education is really a degradation of the human brain to efforts below its natural capacities. This applies especially to book work, in which the memory of sounds in given sequences is often the sole demand of the teacher, and in which the pupil, instead of knowing the meaning of the sounds, often does not know what 'meaning' means. As soon as the sequence of the sounds is forgotten, nothing remains. . . . The efforts of a wise teacher should always be guided with reference to the position and surroundings of a child at home, and should seek to supplement the deficiencies of home training and example. Among the wealthier classes the floating information of the family circle often, though by no means always, both excites and gratifies a curiosity about natural phenomena; but among the poor this stimulus to mental growth is almost, if not entirely, wanting. An explanation of the physical causes of common events, such, for instance, as the rising of water in a pump, would usually be a revelation to the pupils of a Board School, and would start them upon a track which could hardly fail to render them more skillful workers in any department of industry, and which might even lead some of them to fortune. A wise and benevolent squire set on foot many years ago a school for the children of his laborers, in which drawing and the elements of natural science were carefully taught; and the result was that the children educated there, instead of remaining at the plow's tail, passed, in an astonishingly large number of cases, into positions of responsibility and profit."

"Antrum."

"What is the antrum, and why and how is it subject to disease?" *Antrum* means a "cavern." In anatomy it applies to certain cavities in bones, the entrance to which is smaller than the interior. "*Antrum Highmorionum*" (so named from being discovered by Dr. Highmore) "is a deep cavity in the substance of the superior maxillary bone (the upper jaw) communicating with the middle meatus of the nose." It is lined by a prolongation of the mucous membrane which lines the cavities communicating with the nose. This "cavern" is situated from one eighth to three eighths of an inch above the extreme point of the fang of the second bicuspid and first molar teeth, the intervening bone being quite cellular.

Disease of the antrum may occur from an injury to the cheek bone, or either of the teeth above named; possibly from some chronic affection of the nose. More frequently, however, it originates from one of these teeth becoming decayed and diseased at the root. When the peridontium (lining membrane of the tooth's socket) or the pulp of the tooth becomes ulcerated, and the pus is prevented from discharging through the pulp canal of the root, it will necessarily find vent in some direction; usually through the alveolar process and gum—forming an alveolar abscess ("gum boil"). Not infrequently, however, the inflammation and consequent pus find a more ready passage through the cellular tissue of the maxillary to the antrum. If confined to these parts any length of time necrosis (dead bone) follows, and sooner or later produces tumor or cancer. In the earlier stages of diseased antrum, especially when originating from a tooth, the treatment and cure is simple and comparatively painless. It is only necessary to have an opening to the cavity through the alveolus and maxillary, either by extracting the diseased tooth or by an artificial aperture. This passage must be kept open by means of tents until the disease is entirely eradicated and new and healthy tissue takes its place. The treatment consists in injecting the cavity with a mild antiseptic, thoroughly washing out all accumulation of decomposed substance, once or oftener every day, until healthy granulation is completely established.

Just here it is important to repeat, and urge upon the community, parents especially, the fact that the first molars of the permanent teeth come in when the child is six years of age. Also that they are the most important in preserving the contour of the mouth and in masticating the food. They are almost certain to begin to decay when the child is from eight to twelve years of age, and if not promptly filled are certain to give great pain and trouble. They should never be extracted while there is any possibility of saving them by suitable treatment and filling. Parties who have suffered have urged me to elucidate this subject, as a warning to intelligent people not to procrastinate the important matter of preserving the teeth. Nothing but prompt, constant, and scientific attention will save them. Procrastination invariably increases expense and depreciates the teeth, health, and beauty.—*A. H. Trego, D.D.S., in Western Review.*

A New Cheap and Self-generating Disinfectant.

Under this title Dr. John Day, of Geelong, Australia, recommends for use in civil and military hospitals, and also for the purpose of destroying the poison germs of infectious diseases, a disinfectant composed of one part of rectified oil of turpentine and seven parts of benzine, with the addition of five drops of oil of verbena to each ounce.

Its purifying and disinfecting properties are due to the power presumed to be possessed by each of its ingredients of absorbing atmospheric oxygen and converting it into either peroxide of hydrogen or ozone. Articles of clothing, furniture, wall paper, carpeting, books, newspapers, letters, etc., may be perfectly saturated with it without receiving the slightest injury; and when it has once been freely used on any rough or porous surface, its action will be persistent for an almost indefinite period. This may at any time be readily shown by pouring a few drops of a solution of iodide of potassium over the material which has been disinfected, when the peroxide of hydrogen, which is being continually generated within it, will quickly liberate the iodine from its combination with the potassium, and give rise to dark brown stains. It may be applied with a brush or sponge, or if more convenient, as is the case with certain articles, such as books, newspapers, and letters, it may be simply poured over them until they are well soaked; they may then be allowed to dry, either in a warm room or in the open air. It is hardly necessary to say that this disinfectant should never be made use of in the neighborhood of fire or artificial lights for fear of accidents from ignition of the vapors arising both from the benzine and turpentine.

Gilding on Glass.

A new process by M. Dodon is thus given by the *Moniteur de la Céramique:* Gold, chemically pure, is dissolved in aqua regia (1 part nitric and 3 parts hydrochloric acid). The solution effected, the excess of acids is evaporated on a water bath till crystallization of the chloride of gold takes place; it is then taken off and diluted with distilled water of such quantity as to make a solution containing 1 gramme of gold to 200 cubic centimeters of liquid; a solution of caustic soda is then added until the liquid exhibits an alkaline reaction. The solution of gold is now ready for reduction. As a reducing agent an alcoholic solution of common illuminating gas is used. This is prepared by simply attaching a rubber tube to a gas jet and passing the current of gas for about an hour through a quart of alcohol. This liquid (which should be kept in a closed vessel) is added in quantities of from two to three cubic centimeters to 200 cubic centimeters of the alkaline solution of gold before mentioned; the liquid soon begins to turn to a dark green color, and at length produces the metallic layer of gold of known reflecting power.

As an improvement on the process, as well as for convenience in executing it, there may be added to the alcoholic solution of gas an equal quantity of glycerin (28° to 30° Baumé) previously diluted with its own volume of distilled water.

If the gold employed is an alloy, the foreign metals must in all cases be first removed; and especially the least traces of silver, because the very smallest quantity of this metal totally prevents the regular and uniform deposition of the gold.

The bath thus once prepared, it is proposed as a method of gilding mirrors, but also for all the articles of various branches of industry where this process of gilding could be used with success and to advantage, such, for instance, as boxes, necklace beads, candlesticks, glass ornaments, frames of table mirrors, cups, saucers, spoons, lanterns, and reflectors, and for objects generally in glass or crystal that are capable of being completely gilded.

ICES AND ICE CREAMS.

What are termed ices consist simply of the juices of fruits sweetened with sugar sirup and then frozen, like ice cream. It is stated that the best ices are made by first cooking the sugar into the form of a sirup, having a strength of 30°. The fruit juices are strained through a sieve and then added, with a little water and the whites of a few eggs, to the prepared sirup. The final mixture should have a consistence of 22°. It is then frozen in the usual way.

To make the best ice cream it is necessary that the cream should be of the best quality; and the utensils in which it is made must be absolutely clean.

With every quart of the cream mix six ounces best pulverized white sugar, a very little vanilla bean, and the white of one egg. The latter imparts a smoothness and delicacy to the cream that cannot otherwise be obtained. The prepared mixture is then to be stirred in the freezer until it is entirely congealed.

Those who desire first rate ices or cream should follow these directions carefully, and avoid the use of corn starch or other thickeners. Instead of vanilla as a flavor for the cream, a trifling amount of any desired flavoring sirup or juice may be used, as strawberry, pineapple, orange, lemon, etc.

Density of Population and Health.

At a general conference of British architects, a few weeks ago, the general building regulations of the United Kingdom were discussed at length. Among the points brought out were these: 1. That the experience of what are called model lodging houses, such as the Peabody buildings in London and other large towns, combined with that of barracks, workhouses, and schools, furnishes abundant evidence that what is termed density of population is not so detrimental physically as has been hastily assumed; because in such buildings as are referred to the rate of mortality is much less, with a density of 1,500 persons to the acre, than it is in ordinary small houses, with a density of only 250 to the acre. 2. That the health of a community is much more dependent upon food, clothing, and personal habits than upon the arrangement and construction of dwellings or workshops; for however perfect may be the arrangement and construction, they may be entirely neutralized if the food is bad, the clothing deficient, and the personal habits filthy.

The unsanitary conditions of densely populated districts in this city seem to be chiefly due to the fact that the houses of the inhabitants were not originally intended for those who have come to live in them. With dwellings properly constructed for multiple tenancy, properly policed, two or three times as many people to the acre could be healthfully accommodated.

Improvement in Electro-Magnets.

M. Ernest Bisson, in a recent session of the Academy of Sciences, at Paris, announced that he had invented a new method of rolling the wire on the bobbins of electro-magnets. His method (which he has patented) is thus described: At the end of every row he carries the wire back in a straight line to its point of departure, in order to recommence the rolling from the same side as in the preceding rows. He states that he has thus obtained very remarkable results. With the same core of soft iron, the same pile, and the same quantity of the same wire wound in the old way or according to the new method, he finds an advantage of a third (that is, half more) in favor of his invention. His first experiments were made on bobbins of small size; but he has repeated them upon a core of iron about 22 inches long, covered with 35 lbs. of wire measuring over 2,000 feet, and has ascertained that the magnetism obtained opposed a resistance represented by 3 when the wire is wound in the way he describes, and by 2 when it is wound in the old way. Whatever be the cause of the phenomenon, there is no doubt about the fact, which is easy to ascertain.

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THE MANUFACTURE OF INDIA RUBBER.

An industry is easiest created, and progresses best, with cheap raw material and high price of manufactured product; but as processes improve and applications increase, the raw material becomes dearer and the finished goods bring less price. Competition aids to injure the industry when it seeks modes of adulteration or lowering the grade. If consumers know something about the manufacture and about these adulterations, they can aid in keeping up the grade of the product. The india rubber business has rapidly run down. At first the raw material was very cheap, and the product six times as high, weight for weight. Now the finished material sells at about the same price per pound as the main ingredient, often much lower! Unscrupulous makers, knowing that consumers knew nothing about the material or its manufacture, endeavored to keep up the *density* of the products at the expense of their other qualities. Purchasers would have heavy goods, and they got them with a vengeance. The following paragraphs will aid the consumer to distinguish, and the reputable manufacturer to sell, good grades of manufactured caoutchouc.

Caoutchouc is an elastic gum, composed of hydrogen and carbon. It forms as a milky juice, exuding from incisions made in certain varieties of trees growing in nearly all intertropical regions. After partial drying, this juice is sent to us in the shape of pears, balls, slabs, blocks, etc., containing a large proportion of water, and generally much foreign matter, as earth, wood, resin, etc.

Crude caoutchouc comes to our factories in different shapes; each country producing it having its peculiar manner of gathering, drying and shipping.

Our engraving shows the manner of gathering and drying rubber in the province of Pará, in Brazil. The tree is tapped in the morning, and during the day a gill of fluid is received in a clay cup placed at each incision in the trunk; this, when full, is turned into a jar, and is ready to be poured over a pattern of clay or a wooden last covered with clay, the form of which it takes as successive layers are applied. Its drying and hardening are hastened by exposure to the heat and smoke of a fire.

The quality is more variable than the appearance. All india rubber, when perfectly freed from foreign matters, possesses the same physical and chemical properties, but in varying degrees; the prices, on this account, varying even 100 per cent; thus, the price of African gum being unity, that of Pará is 2 and even 2½. The African gums lose much in washing; however, the difference in the loss is far from equaling that in the price.

Completely pure india rubber is solid and white; density 0·925; at our normal temperature (say 15° to 20° C., equal to 59° to 68° Fah.) it has great elasticity, which it loses below 0° C. or above 50° C. (32° and 112° Fah.); freshly cut surfaces rejoin with the greatest ease. It is unalterable by alkalies or strongest acids; however, it is destroyed by boiling nitric or sulphuric acid, or by a cold mixture of these two. It is more or less soluble in turpentine, liquid coal oils, sulphuric ether, bisulphide of carbon, and all fatty bodies.

At first, caoutchouc was manufactured and used in its normal state. It was cut into strips, and threads, and stretched into sheets; with these strips or sheets were made tubes and other similar objects possessing all the above mentioned properties. But despite these advantages, these objects had the undesirable property of hardening with cold and softening with heat, which greatly hindered the employment of caoutchouc; and its use could never have attained a great development if the discovery of "vulcanization" had not opened out new and unexpected avenues.

Normal caoutchouc being very little used in the arts, it is important to study it in the vulcanized condition.

The first process to which all grades of rubber are submitted is washing, generally effected by passing through cast iron rollers, having different speeds, and drenched by a current of water. The difference of speeds produces a tearing of the rubber, and exposes all its particles in succession to the action of the current of water; the impurities adhering are carried away; and instead of sheets having an integral section, there are obtained granulated and flaky strips, very well suited for subsequently drying out not only the washing water but that contained in the gum on its arrival.

Drying is done in chambers heated to 20° to 50° C. (68° to 112° Fah.), according to the gum. The loss from washing and drying (it is very important that the latter be complete) is at least 12 per cent for "dry and fine" Pará gums, 18 to 25 per cent for medium grades, 30 to 48 per cent for inferior grades.

The preparation is continued by grinding and kneading, which can be done by passing the gum alone through powerful crushers, or by passing it, mixed with solvents (as benzine or bisulphide of carbon), through less powerful apparatus.

These grindings and kneadings have a double purpose; they increase the adhesive qualities of the natural gum, and bring it into the semi-pasty state necessary to its rolling out into sheets or its application to fabrics.

The making into sheets is done either by huge calender rolls heated by steam or by spreading or stretching machines.

Sheets of pure rubber or of rubber-coated fabric are the starting point of nearly all manufactured objects, such as vulcanized threads, clothing, belts, hose and tubing, valves, toys, etc. These are vulcanized after being made up, and are then put into the market.

GATHERING AND DRYING RUBBER IN PARA.

If a certain proportion of flowers of sulphur be intimately mixed with well washed, dried, and kneaded rubber, and the mixture be placed under such conditions as to lead to the crystallization of the sulphur, there is effected a complete transformation. The soft and little tenacious product becomes elastic and tenacious; it was adhesive, sticking easily to itself, and dissolving readily in essences, and now it is no longer coherent when freshly cut, and is completely insoluble in all known menstruums. From being hardened by cold and softened by heat, it preserves its elasticity from the lowest temperatures almost to its point of decomposition, or about 180° C. (356° Fah.).

Caoutchouc thus transformed has received the name of "vulcanized" rubber,* and the term vulcanization is applied to the time during which this remarkable change takes place.

Does vulcanizing cause a chemical combination between the sulphur and the caoutchouc, or are the properties which it communicates to the gum simply the result of the interposition and the crystallization of the sulphur in its pores? It seems necessary to suppose both cases in explaining all the facts pending and subsequent to vulcanization.

When the vulcanized objects are not over 0·0015 millimeter in thickness, vulcanization can take place at the same time with the introduction of the sulphur; it sufficing to plunge the objects in a solvent of caoutchouc, susceptible of being mixed with a sulphur compound which decomposes easily and liberates free sulphur, such as a mixture of bichloride of sulphur and sulphide of carbon, or of benzine and bisulphide of hydrogen. During immersion, the solvent swells the rubber and penetrates into its pores, carrying with it the sulphur compound; the object is withdrawn very soon and the solvent evaporated, resulting in the abandonment and crystallization of the sulphur.

Another method consists in exposing the object to be vulcanized in a bath of melted sulphur at about 125° to 150° C. (257° to 302° Fah.). These two processes have the disadvantage of being inapplicable to thick objects; furthermore, their execution is delicate, demanding great skill. They are thus little employed and of insignificant importance compared with that consisting in the introduction of sulphur and mixing it mechanically during the kneading which the gum must undergo in any case. This does not in the least interfere with the making of the sheets or other objects, which are then placed either in a heater tightly closed and kept at a high temperature, by steam or hot air; or in liquid baths at a temperature of 112° C. (say 234° Fah.), the melting point of sulphur.

For a given quantity of caoutchouc there are three variable elements: the quantity of sulphur, the temperature of vulcanization, and its duration.

The action of the sulphur upon the rubber not causing a definite combination (if indeed there be any actual combination), one cannot, in the present state of the art, give precise rules for the relation of these three variables; one can only say, in general terms, that there must be (1) the least possible quantity of sulphur, (2) the temperature be as little as practicable above the melting point of sulphur, and (3) the vulcanization must be as prolonged as practical manufacture permits.

It is no less difficult to point out the characteristics enabling one to recognize, when the operation is concluded, whether the object be well or badly vulcanized. Long experience gives certain indefinable tests or indications; however, although very important, these do not afford the exact certainty which the importance of the subject renders so desirable.

Vulcanizing, the crowning point of the manufacture, is also the most delicate and serious. Done under good conditions, all other things being equal, it gives an object its maximum of good qualities. Badly done, it gives them the same qualities for a short time, after which they quickly disappear; and before long the rubber loses its elasticity, becomes hard and brittle, and cracks and splits with the least little thing. Badly vulcanized rubber goods lose all merchantable value, and are fit only to be ground up and mixed as so much inert matter (often hurtful matter) in other manufactured objects.

The discovery of the influence of sulphur on normal rubber was due to chance, which was also, for a long time, the only guide of the first manufacturers. Afterward, for each kind of rubber, there were combined, in every possible manner, the three variables of sulphur, temperature, and time. Specimens were made and carefully kept and examined after several years, this examination showing what were the combinations best adapted to practical use.

If, on the one hand, one thinks of the numerous grades and qualities of the crude gum, and on the other one figures up all the combinations which can be given to the three variables, one will understand the multiplicity of the preparations of india rubber, and also the secrecy with which the manufacture is still surrounded, each maker naturally guarding the happy combinations which he has discovered.

The gum, during the grindings and kneadings preceding its moulding or spreading, can receive, besides the sulphur necessary to its vulcanization, other and very widely differing additions. The employment of these additions has been caused by the necessities of manufacture and by the aid which adulteration gave in lowering the price.

For the latter purpose, there is generally used old ground up vulcanized rubber. This worthless débris is ground to

* Goodyear at first used the word "metallized."

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fine pulp, and can be mixed with normal gum in indefinite proportions. It defies the test of specific gravity and the most minute analysis, and permits the manufacturers to say that they "use only pure rubber;" while it really lowers the elasticity and tenacity of the goods, in proportion as it is used. It has been endeavored to lessen the bad effect of its addition by attempts at devulcanizing it, that is, at multiplying the effect of the sulphur and bringing the material back to the normal state; but notwithstanding the most earnest efforts and researches, the result has not been completely obtained. The gum has been decomposed and then given an adulterant with a value a little greater than purified mineral bitumens; but it has not been devulcanized, and, whatever its condition, the material still remains only the most easily employed adulterant of pure caoutchouc, and consequently the greatest enemy of pure fabrications.

The foreign matters generally employed are earthy or metallic salts. They are either inert, that is, exercising, at the temperature of vulcanizing, no chemical action upon the mixture of sulphur and gum; or they are active, that is, forming sulphides in the pores of the raw goods, and at the temperature named.

Inert materials are introduced either to give colors more pleasing than the natural one (in which case zinc white, lampblack, vermilion, etc., are used), or to reduce the too great elasticity of the pure material (for this purpose powdered chalk, talc, kaolin, etc., answer).

Active materials are to facilitate vulcanization, and are principally employed when the rubber is to be applied to preserve or join tissues. The combination of these active materials with proportions of sulphur and of gum effects in the mass a disengagement of heat, which simplifies the work due to vulcanization and permits of lessening the temperature and duration, which are highly conducive to the longest possible duration of the prepared tissues. Lead salts being cheap, and having a great affinity for sulphur, are given the preference. Lime and calcined magnesia answer well, but can be added in but small proportions, their principal rôle being to prevent the holes or cracks produced by the sulphur vapor in certain combinations containing a large proportion of admixture, or in pure preparations that are too much worked.

There are employed certain undefined polysulphides, so prepared as to contain free sulphur precipitated at the time of their formation. Of these we might mention sulphide of antimony, which gives that preparation of caoutchouc known as mineralized; also the analogous supersulphides of lead. These salts are difficult and expensive to make, and their high price prevents their use in making goods of secondary importance.

ASTRONOMICAL NOTES.

BY BERLIN H. WRIGHT.

PENN YAN, N. Y., Saturday, August 17, 1878.

The following calculations are adapted to the latitude of New York city, and are expressed in true or clock time, being for the date given in the caption when not otherwise stated.

PLANETS.

	H.M.		H.M.
Mercury sets	7 44 eve.	Saturn rises	8 30 eve.
Venus rises	2 56 mo.	Saturn in meridian	2 29 mo.
Jupiter in meridian	10 21 eve.	Neptune rises	9 59 eve.

FIRST MAGNITUDE STARS.

	H.M.		H.M.
Alpheratz rises	6 26 eve.	Regulus	invisible.
Algol (var.) rises	8 06 eve.	Spica sets	8 57 eve.
7 stars (Pleiades) rise	1026 eve.	Arcturus sets	11 37 eve.
Aldebaran rises	11 45 eve.	Antares sets	10 56 eve.
Capella rises	9 12 eve.	Vega in meridian	8 48 eve.
Rigel rises	1 55 mo.	Altair in meridian	9 59 eve.
Betelgeuse rises	1 41 mo.	Deneb in meridian	10 52 eve.
Sirius rises	3 57 mo.	Fomalhaut rises	9 06 eve.
Procyon rises	3 31 mo.		

REMARKS.

Venus is in the constellation *Gemini*, about 2° from its eastern boundary, and exactly in the earth's path, being at her ascending node. Jupiter is in the head of the Goat; and a line drawn from *a Capricorni* (a quintuple star) through *β Capricorni*, and produced 5°, will pass through Jupiter and form an arc of 8°. A most interesting occurrence may be witnessed by watching Jupiter's satellites on the evening of August 15. At 11h. 23m. evening the fourth satellite appears at Jupiter's eastern limb, having been occulted, continues moving eastward for twenty-seven minutes, and then disappears in Jupiter's shadow, not to emerge until after he has set. At the above mentioned time the first satellite is very near inferior, geocentric conjunction, and is therefore making a transit, having disappeared at 10h. 49m. evening, and reappearing at 1h. 9m. morning, of the 16th; the second is west of Jupiter, and is moving toward the planet; and the third is east about twice the distance of the second, and moving from the planet. With a good telescope the shadow of the first satellite may be seen, as a dark spot, to cross Jupiter's western limb thirty-three minutes after it begins the transit referred to, and to pass off at the east thirty-three minutes after the satellite does. Uranus will be in conjunction with the sun August 22.

The Undeveloped Regions of the Southwest.

An argument for the Texas Pacific Railroad dwells at great length upon the vast extent of territory to be developed by the road. All of Western Texas, all of New Mexico, Arizona, Southern Nevada, Southern Utah, and a large portion of Northwestern Mexico would be tributary to the road, an area of about half a million square miles in extent. The part within our own national bounds is equal in size to Germany and France combined, or enough to make ten States the size of New York, in all of which there is not a single mile of railway. The assertion that there was not enough arable land left in all the region to make a good sized county in Wisconsin was resented as a libel; a large part was unquestionably sterile, yet there remained a very considerable area of the highest fertility. The valleys of New Mexico, Arizona, and the bordering States of Mexico are exceedingly productive, when irrigated or where the supply of moisture is sufficient. The wheat is equal to that of California. Corn is a staple product, and in some parts two crops a year can be grown. Oats, barley, rye, peas, beans, and other food crops grow well and are very productive. According to locality, the peach, nectarine, apricot, plum, pear, and grape do well; oranges, lemons, olives, mangoes, bananas, and pine apples flourish; and sweet potatoes, rice, sugar cane, tobacco, cotton, coffee, cocoa, and indigo grow to perfection. Here too is one of the best wool growing regions of the Union; winter feeding is almost wholly unnecessary, and the pure dry atmosphere forms a perfect indemnity against foot rot and like diseases. The mining interests that would be developed by the road are admittedly very great. Our relations with Mexico and with the Southern Indians would be very much improved by the influence of the road. Areas along the Union Pacific, previously supposed to be beyond redemption, now bear abundant crops; a like effect would follow the building of the Southern road. Already settlements in anticipation have preceded the construction of the road in Texas. Complete it, and intelligence, science, and energy will bring into action dormant power now useless and almost unknown.

New Engineering Inventions.

Henry Exall, of Richmond, Va., has patented an Endless Chain Propeller, in which two endless chain propellers, moving around sprocket wheels, are arranged to run in open channels beneath the boat upon opposite sides of the keel, and propel the boat by securing a decided anchorage in the water. The main points of novelty are in the construction of the chain propellers, each of which is made of rod sections carrying midway between their jointed ends rigid disk paddles, the jointed ends being coupled by a shell which forms with nuts on the ends of the rods a double ball and socket joint, and also affords a hold for the grabs of the sprocket wheel. By inclosing the return chain box and supplying it with suitable pipes the current of air produced therein is utilized for purposes of ventilation. A vessel embodying the improvements is, we are told, being built at Richmond, Va.

John Paul, of La Crosse, Wis., has patented an improved Log Slide or log way employed in a sawmill for drawing up logs. The invention consists in an improved form of the slide and a novel construction of the links of an endless chain serving as a log carrier, whereby the operation of drawing the logs up the slide is greatly facilitated, and the labor considerably lessened.

Edward Huber, John C. Titus, Edward Durfee, and James F. Swinnerton have patented a Portable Engine. The objects of this invention are to lessen the bulk or size and thereby reduce the weight of the engine, as compared with others of its class; also to obviate the danger of injury to flues or flue sheet, and the labor, delay, and expense incident to repair of the same. The engine possesses several other novel features, which cannot be properly described without an engraving.

Charles E. Clark, of Rochester, N. H., has patented an improved Hose Pipe and Nozzle, which is made in straight sections of different diameter, and provided with an inwardly projecting annular edge at the inner end of each section, the object being to reduce the friction between the water and inner surface of the pipe and nozzle by dispensing with tapering surfaces and causing a portion of the water to act as a guide or friction surface for the stream passing through the nozzle.

Walter Dawson, of Scranton, Pa., has patented an improved Feed-water Heater for Locomotives, in which the surplus steam is conducted from the boiler and discharged into the tender through a pipe suitably arranged for the purpose, thereby effecting a considerable economy of fuel by heating the water preparatory to its entering the boiler by means of the surplus steam which is not required for working the engine.

Earthquakes and Eruptions.

The year 1878 has already seen more than its fair share of disastrous earthquakes and similar phenomena. There are slight *tremblements de terre* in one part or another of the earth's surface about once in three days, but it is only occasionally that serious outbursts occur which overwhelm cities, swallow up whole islands, or raise up the bed of the sea from a fathomless depth to a dangerous shoal. During the first half of the present year, however, the intensity of the shocks of earthquake and of volcanic eruptions has undoubtedly been on the increase, and if this continues the thousandth anniversary of the destruction of Herculaneum and Pompeii, which will occur next year, will be celebrated in an appropriate, if an undesirable, manner, by the forces of nature itself. This activity has developed itself since June, 1877.

In the whole of 1877 there occurred, according to the compilations of Professor Fuchs, 109 recorded earthquakes, though from our own observations we believe the number to have been somewhat larger. In the three months of June, July, and August there were only 11 earthquakes; while 34 occurred in September, October, and November, and the rest in the previous six months back to December 1, 1876. As usual, the most violent of these phenomena were those occurring in South America. The damage done to Iquique, Valparaiso, Lima, and other cities by the outbreak of May 9, 1877, was enormous, the vibrations recurring with startling rapidity, and lasting over several days. A few days later a submarine volcanic eruption occurred off the coast of Peru, which also did great damage to shipping. The effects of these disturbances were felt in all parts of the Pacific. During the year, several minor earthquakes, though of unusual intensity for the part of the world in which they were felt, occurred in Europe. Those of April 4, May 2, and October 8 in Switzerland, and of November 1 and 4 and December 22 at Lisbon, were the most alarming. Fortunately, little or no serious damage was done.

The volcanoes of Europe were unusually inactive during the year, but in South America, in Japan, and in the Pacific generally, the year was marked by several very violent volcanic explosions. The frequency with which outbreaks of this nature were observed in the open sea was a peculiarity of the year. Thus in February a very remarkable eruption occurred in the seas surrounding the Sandwich Islands, ten days after a violent outburst of the crater of Mauna Loa, on the mainland of the group, and a few weeks before another most remarkable outflow of lava from the celebrated lava lake of Kilauea. Here vast jets of liquid lava were ejected to a great height through the hard crust of the solidifying lava of the lake, which had lain undisturbed for many years. Much more serious was the eruption of Mount Cotopaxi in June, accompanied by terrible showers of ashes, dust, and mud, which were carried by the wind far and wide over the country, devastating the fair lands and destroying hundreds of lives. The insular volcano of Ooshima, in Japan, broke out in flames and burning lava on January 4, and continued in violent action till the first week in February, causing, in combination with the earthquakes which accompanied it, a disastrous loss of life.

Among the more noteworthy events of the year was the eruption of a new volcano in a district hitherto supposed to be free from volcanic disturbance—namely, on June 11, in a new crater near the Colorado river, California. About the same time an earthquake was felt in Canada. The submergence of several islands in the great archipelago lying between the Malay Peninsula and Australia, the upheaval of new lands in the same district, and the observance of the effects of volcanic phenomena in the deep waters of the South Atlantic, and where the sea is some 20,000 feet deep, would have been sufficient of themselves to mark the past year as an uncommon period of strange volcanic phenomena. As already hinted, however, we believe that the current twelve months will, unless a sudden cessation of activity occurs, prove to be even more prolific of such events than any of its recent predecessors.—*London Times.*

India as a Wheat Producer.

The amount of wheat sent from India to England in 1877 has given rise to the belief that within a few years England would be practically independent of America with regard to this element of her food supply. The Madras *Mail* disputes the proposition, alleging that "the fact is, India exports not because she has a surplus, but because the people are too poor to retain the food now exported. Were the people able to afford it, every pound of grain produced would be eaten. A very large proportion of the inhabitants of this presidency do not know what a really hearty and satisfactory meal is from year's end to year's end. In Madras the cultivators have to pay £4,500,000 annually in the shape of rent, and must sell their grain to get the cash needed to give to the tax-collector. Again, much of the grain exported goes to pay for the scanty clothing of the people, for the cotton fabrics worn are mainly of Lancashire weaving. As regards the wheat trade from the northwest provinces, it is clear that the great export for a time was due to the people parting with their usual reserve. What has been the result? Why, as the effect of the failure of a single harvest, Sir George Couper has had to encounter not merely scarcity, but actual famine."

Labor in Ireland.

The United States Consuls at Dublin and Cork have forwarded to the Department of State specific information with regard to rates of wages in Ireland. The former reports that the skilled mechanic gets per day 6s. 6d., and the unskilled mechanic receives 17s. 6d. per week. Agricultural laborers are paid per day from 1s. 2d. to 2s. 6d. permanent, and from 2s. 6d. to 3s. 6d. in the busy season, the rate of wages varying very much according to locality and season. Near large towns the rate is much higher than in the country districts; also, in spring and harvest the rate is higher than at other seasons.

The Consul at Cork reports that agricultural laborers get 48 cents a day; coal heavers, machinists, gas fitters, and bakers, $1.09; masons, shoemakers, painters, and joiners, $1.21. On public works, laborers earn from 48 to 60 cents a day. On the railways conductors receive $4.38 to $7.29 per week; engineers, $1.21 to $1.70 per day. Last summer the railway employes struck for an advance, but failed. The cost of living to the laborer and the mechanic is about $85 per annum. Trade is much depressed, with many failures. Wages and cost of living have increased about one sixth since 1873.

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Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Lubricene.—A Lubricating Material in the form of a Grease. One pound equal to two gallons of sperm oil. R. J. Chard, New York.

ForPower&Economy,Alcott's Turbine,Mt.Holly,N.J.

Foundry and Machine Shop, in live Western town, for sale cheap. Address Box 275, Winona, Minn.

Fan Blowers Cheap. Unadilla (N.Y.) Machine Works.

Bolt Forging Machine & Power Hammers a specialty. Send for circulars. Forsaith & Co., Manchester, N. H.

Howard Patent Safety Elevators. Howard Iron Works, Buffalo, N. Y.

A Lee Moulding Machine, second-hand, but as good as new, cost $800, will be sold for $500, including a lot of cutters that cost over $150. I.N.Keyes, Worcester, Mass.

Catalogue of Scientific Books. Mailed free on application. E. & F. N. Spon, 446 Broome St., New York.

Wanted.—A good second-hand or new Bolt Heading Machine, with latest improvements. Address Frick & Co., Waynesboro, Franklin Co., Pa.

Wanted.—A Combined Power Punch and Shears for light work. 209 West 33d St., New York.

For the most durable and economical Paint for cars, roofs, bridges, iron, brick and wooden buildings, address Pittsburg Iron Paint Company, Pittsburg, Pa.

Improved Steel Castings; stiff and durable; as soft and easily worked as wrought iron; tensile strength not less than 65,000 lbs. to sq. in. Circulars free. Pittsburg Steel Casting Company, Pittsburg, Pa.

J. C. Hoadley, Consulting Engineer and Mechanical and Scientific Expert, Lawrence, Mass.

For Town and Village use, comb'd Hand Fire Engine & Hose Carriage, $350. Forsaith & Co., Manchester, N. H.

Boilers ready for shipment, new and 2d hand. For a good boiler, send to Hilles & Jones, Wilmington, Del.

Best Steam Pipe & Boiler Covering. P.Carey, Dayton, O.

Foot Lathes, Fret Saws, 6c., 90 pp. E.Brown, Lowell, Ms.

Sperm Oil, Pure. Wm. F. Nye, New Bedford, Mass.

Power & Foot Presses, Ferracute Co., Bridgeton. N. J.

Punching Presses, Drop Hammers, and Dies for working Metals, etc. The Stiles & Parker Press Co., Middletown, Conn.

Alcott's Turbine received the Centennial Medal.

All kinds of Saws will cut Smooth and True by filing them with our New Machine, price $2.50. Illustrated Circular free. E. Roth & Bro., New Oxford, Pa.

Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing Metals. E. Lyon & Co., 470 Grand St., N. Y.

Nickel Plating.—A white deposit guaranteed by using our material. Condit, Hanson & Van Winkle, Newark, N.J.

Cheap but Good. The "Roberts Engine," see cut in this paper, June 1st, 1878. Also horizontal and vertical engines and boilers. E. E. Roberts, 107 Liberty St., N. Y.

The Cameron Steam Pump mounted in Phosphor Bronze is an indestructible machine. See ad. back page.

1,000 2d hand machines for sale. Send stamp for descriptive price list. Forsaith & Co., Manchester, N. H.

Presses, Dies, and Tools for working Sheet Metals, etc. Fruit and other Can Tools. Bliss & Williams, Brooklyn, N. Y., and Paris Exposition, 1878.

Manufacturers of Improved Goods who desire to build up a lucrative foreign trade, will do well to insert a well displayed advertisement in the SCIENTIFIC AMERICAN Export Edition. This paper has a very large foreign circulation.

Band Saws, $100; Scroll Saws, $75; Planers, $150; Universal Wood Workers and Hand Planers, $150, and upwards. Bentel, Margedant & Co., Hamilton, Ohio.

Patent Wood-working Machinery, Band Saws, Scroll Saws, Friezers, etc. Cordesman, Egan & Co., Cincin'ti, O.

Diamond Tools. J. Dickinson, 64 Nassau St., N. Y.

Improved Wood-working Machinery made by Walker Bros., 73 and 75 Laurel St., Philadelphia, Pa.

Dead Pulleys, that stop the running of Loose Pulleys and Belts, taking the strain from Line Shaft when Machine is not in use. Taper Sleeve Pulley Works, Erie, Pa.

North's Lathe Dog. 347 N. 4th St., Philadelphia, Pa.

Boilers & Engines cheap. Lovegrove & Co., Phila., Pa.

Bound Volumes of the Scientific American.—I will sell bound volumes 4, 10, 11, 12, 13, 16, 28, and 32, New Series, for $1 each, to be sent by express. Address John Edwards, P. O. Box 773, New York.

For Solid Wrought Iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, etc.

Pulverizing Mills for all hard substance and grinding purposes. Walker Bros. & Co., 23d and Wood St., Phila.

Best Turbine Water Wheel, Alcott's, Mt. Holly, N. J.

NEW BOOKS AND PUBLICATIONS.

THE SALE AND INTRODUCTION OF PATENTS, AND PATENTEES' DIRECTORY. By Jas. H. Edwards. Published by the Keystone Publishing Co., 326 Penn avenue, Pittsburg, Pa.

This volume contains practical advice designed to assist inventors in disposing of their patents by instructing them how to place the same before the public. The author seems to have had considerable experience in the business, and details what he thinks ought to be done with great minuteness. He undertakes a difficult task, however, when he assumes to lay down rules which are presumably applicable to all inventions. Few new devices, we imagine, are sold by personal canvassing in an unknown field, on the part of the inventor, book agent fashion, and we disagree with the writer in the apparent assumption that people who have no immediate need for new inventions can be talked into a conviction to the contrary. We have always advised inventors to attend to their own business and make their own disposals; and we know that the cheapest and best mode of introducing inventions is through the columns of this journal. Beyond this the subject is a matter for judgment and business tact, depending greatly upon special circumstances, under many of which the advice in this volume, in common with the lists of business houses given, may prove of utility.

Notes & Queries

(1) W. & B. ask how to turn and polish glass in a lathe, such as lens for microscopes, etc. A. Turn two pieces of brass, one concave and the other convex. Grind one into the other until they become spherical. Cement a small disk of glass to the end of a stick and shape it roughly on a common grindstone, then as the concave brass piece is revolved grind the glass in it, applying emery and water. The glass must be moved around to prevent scratching, and as it takes the proper form finer emery must be applied. When at last the surface is semi-polished and free from scratches, the concave brass surface may be covered with rosin and pitch equal parts. This must be shaped while warm, and as the lathe revolves, by means of the convex brass, which is wet to prevent adhesion. The lens may now be finished in the pitch form by applying a thin paste of rouge and water.

(2) P.—You do not send sufficient data. Consult Trautwine's "Engineer's Pocket Book," or Boller's treatise on "Highway Bridges."

(3) A. S. asks what amount of bluestone it takes for one cell of gravity battery. A. Two lbs.

(4) A. L. asks which of the three kingdoms, namely, animal, vegetable, or mineral, can water most properly be said to belong. If not belonging to any, to which kingdom does it most approximate? A. It may be classified with the last named.

(5) M. E. R. asks for a good, durable and cheap brown wash for outside woodwork, as fences and the like. A. 1. Coal tar dissolved in benzine affords a brown wash much used in some sections. 2. Slake half a bushel of lime in boiling water, strain it through a fine sieve, and add a peck of salt previously dissolved in hot water, 3 lbs. of rice boiled to a paste, and 1 lb. of glue softened, and dissolved in a little hot water. Then stir in a sufficient quantity of ocher to produce the desired color, and let the mixture stand for several days in a covered vessel. This wash is preferably applied hot.

(6) J. A. R. asks: What is the best formula for making baking powder? A. Powder and thoroughly dry separately by gentle heat ½ lb. tartaric acid, ¾ lb. of pure bicarbonate of soda, and ¾ lb. of potato farina. Mix dry, pass through a sieve, and preserve as much as possible from air and moisture.

Please give me full directions for making a simple battery for silver plating. A. See pp. 396 (44), 92 (39) and 268 (45), vol. 37, and 155 (17) and 123 (1), vol. 38, SCIENTIFIC AMERICAN.

How is soluble coffee prepared, such as is called "soluble coffee, made in one minute without boiling"? A. The soluble extract is made by concentrating or evaporating the strong aqueous infusion at a moderate heat in vacuo.

Let me know the process for manufacturing rubber stamps, and what kind of rubber is used. A. See p. 1326, SCIENTIFIC AMERICAN SUPPLEMENT, and p. 48, current volume SCIENTIFIC AMERICAN. The strips sold by the rubber companies for this purpose consist of caoutchouc with about 6 per cent of sulphur.

(7) E. E. P. asks: Is it possible for me to become a thorough pharmacopolist by self instruction? A. We think you should spend a year or so in a pharmacy.

(8) G. A. H. asks: 1. What is the lifting power of 100 cubic feet hydrogen gas? A. 100 cubic feet of pure hydrogen is about 7 lbs. lighter than an equal volume of atmospheric air under the same conditions of pressure and temperature. 2. Also, the lifting power of 100 cubic feet of common illuminating gas? A. Coal gas is about twice as heavy as hydrogen. 3. Is the single gas generator mentioned July 20 in SCIENTIFIC AMERICAN suitable and most convenient for inflating a baloon of 150 lbs. lifting power? A. No. 4. What is the proportion of water to add to the acid? A. About 1 of acid to 5 of water.

(9) T. L. G. asks how hydrogen and oxygen gases are separated. A. If the gases are simply mixed, pass the mixture slowly through a strong aqueous solution of sodium pyrogallate made slightly alkaline by excess of the bases; the solution will absorb the oxygen. When in combination (OH_2=water) they may be isolated by means of a strong current of electricity passed through the liquid between platinum electrodes; oxygen then escapes at the anode and hydrogen at the cathode, so that the gases may be collected separately by inverting immediately over the respective poles bottles filled with water to displace the air.

(10) J. P. E. asks how to remove rust spots from a sword blade. A. Apply a little fine emery and oil, and finish with crocus and rouge.

(11) S. D. M. asks: 1. Can steam be condensed fast enough to be used over and over as the agent of power in the steam engine, the injector being used to force the water into boiler? And if so, would it not be economizing fuel to use alcohol which boils at 173° Fah. instead of water with a boiling point of 212° Fah.? A. Steam is used in this way frequently in the case of engines with surface condensers. There is not generally any economy in the use of a liquid having a lower boiling point than water. 2. Is it necessary that the supply water be cold for the Giffard injector to work satisfactorily? A. The injector, as made at present, will take hot water. 3. Do methylated spirits produce a hotter flame than alcohol? A. No. 4. Of the two which is the most expensive? A. Alcohol.

(12) L. P. C. writes: A friend and myself had a dispute in regard to the circumference of the drive wheels of a locomotive. He claims that a locomotive having wheels large in circumference (everything else being equal) will pull the heaviest load. I believe a locomotive having small wheels (everything else being equal) will pull the heaviest load. A. The rule for determining the tractive force of a locomotive in pounds is: (Diameter of piston in inches)^2×length of stroke in inches × mean pressure in cylinder in lbs. per square inch ÷ Diameter of driving wheel in inches. From this you will see that, other things being equal, the tractive force increases as the diameter of the driving wheel diminishes.

(13) C. & B. ask for a recipe for making the metal used in fusible plugs in common use in the crown sheet of tubular boilers. A. There are a number of fusible alloys, a good selection of which may be found in the article "Alloy," in "Knight's Dictionary." One of the lists is as follows:

Tin.	Lead.	Bismuth.	Mercury.	Melting point. Fahrenheit scale.
1	25			558°
1	10			541°
1	5			511°
1	3			482°
1	2			441°
1	1			370°
1½	1			334°
2	1			340°
3	1			356°
4	1			365°
5	1			378°
6	1			381°
4	4	1		320°
3	3	1		310°
2	2	1		292°
1	1	1		254°
1	2	2		236°
5	3	3		202°
5	3	3	3	122°

(14) Old Reader asks: 1. What should be the fall per 100 feet to gravitate coal cars (contents one ton), length of track one half mile, empty cars to be hauled back to shaft by wire rope, with stationary engine at shaft? A. One foot or less will answer. 2. And would ⅝ wire rope be strong enough to handle trains of from 20 to 30 cars? A. It would be better to use 1 inch rope.

(15) S. asks: Has an engine ever been invented that would run or was propelled by the expansive force of water (in the hydrostatic press, for instance, great power may be exerted)? Has this power ever been utilized in propelling an engine? If not, what are the difficulties in the way? And if it has, why has such a machine not come into general use? A. We understand you to refer to water pressure engines, which are used to a considerable extent in localities where there is a sufficient head and supply of water, but which are not so cheap or simple as many varieties of water wheels.

(16) F. A. C. writes: I am making some fine plaster of Paris castings, and find upon pouring that the metal sputters, boils up, and blows out without settling down into the mould. Will you be kind enough to inform me of the cause as well as the remedy for the same? A. Mix sand or pulverized pumice stone with your plaster to render it porous, and provide air vents. Thoroughly dry the plaster mould. You will find full directions for making moulds of this kind in SCIENTIFIC AMERICAN SUPPLEMENT No. 17.

(17) J. W. P. asks: At what degree of heat would water be blowing off steam at 150°? A. The temperature of the water would be about 366° Fah.

(18) L. H. B. asks: What is the fastest time ever made by a Mississippi steamboat? What is the fastest time made by Hudson river steamboat? Give length of largest steamer on each of above rivers. A. As these are all questions about which there is considerable discussion, we must ask some of our readers to send replies.

(19) F. J. G. writes: I have a small induction coil which gives about a ⅝″ spark. I have taken it apart and find the wire of the secondary coil to be uninsulated; each layer of wire being separated from the rest by 3 thicknesses of paper. 1. Can I by better insulation produce better results? A. Yes. 2. What is the easiest and best way to do it? The wire is about No. 32, and a little over a mile long. A. It may easily be covered with shellac varnish before winding. Silk covering, however, is the best.

(20) W. S. writes: I am building an engine of the inverted cylinder type, 2 inch bore by 3½ inch stroke, steam ports ¾ x ⅛, exhaust ¾ x ⅜. I wish to run it from 250 to 300 revolutions per minute, with 50 lbs. pressure. Will ⅛ inch copper boiler 14 inches diameter x 2 feet 9 inches high, with flue tapering from 14 inch at bottom to 3 inch at top, do? If not, what size and thickness of wrought iron? What size should pump be? A. We think these dimensions will answer. The pump plunger can be ⅜ inch in diameter.

(21) C. E. B. C. writes: I am running a saw mill, cylinder 12 in., 4 foot stroke, driving wheel 20 feet, drum on saw mandrel 2 feet. I wish to know if the working capacity of the mill would be increased or decreased by lessening the size of the main wheel? A. This would decrease the capacity if the speed of the engine remained the same as before the change.

(22) O. P. asks: 1. What quantity of iron filings, and what proportion of sulphuric acid to water, are needed to produce in 2 hours 25 cubic feet of hydrogen? A. 25 cubic feet of hydrogen = 2·14×17·28×25, or about 925 grains (at 60° Fah. and 30 inches barometric pressure). $\underset{56}{Fe} + \underset{98}{SO_4} = \underset{152}{FeSO_4} + \underset{2}{2H}$. Then 2 : 56 = 925 : x = 3 lbs. (nearly) of iron; and 2 : 96 = 925 : y = about 6½ lbs. of sulphuric acid (specific gravity 1·8). The acid must be diluted with 5 or 6 volumes of water for use. 2. Will this hydrogen be adapted for feeding a retort gas stove? A. Not very well.

(23) "Inquisitive" writes: 1. Having tried to make a battery as described in the July 29, 1876, number of the SCIENTIFIC AMERICAN, I failed. I did as was described. Will you give me a little information as to it? Is there a wire inside the cylinder, and is it coiled? What kind of zinc should I use? A. The cylinder is solid cast zinc. 2. The first one I made I left it over night, and in the morning the cylinder was all ate up. Can you give me the reason? A. Your paper diaphragm must have been defective.

(24) L. S. asks what size of hot rolled iron to use for a countershaft making 425 revolutions per minute, driving a circular saw 24″ diameter sawing live oak; saw making 1,200 revolutions per minute. Shaft bearings placed at intervals of 8′. A. 2⅛ inch shaft will answer.

(25) J. D. Q. asks if there is anything better than red lead to make up steam pipe joints. A. We believe this is as good as anything else.

(26) J. A. H. writes: If we take a pair of scales (even balanced) and place the beam in an inclined position, why will it not remain so? There is not only friction to prevent, but most scale beams are so made that by far the greater part of the weight lies above the fulcrum, in which case its natural tendency when once out of its horizontal position would be to depart still farther from it. Where then is the power sufficient to overcome these obstacles and to bring the beam to its horizontal position? A. The center of gravity of the beam of a balance is always placed a little below the fulcrum to insure stable equilibrium. If the center of gravity of the beam and the fulcrum coincide, then the beam when balanced will remain in any position in which it is placed.

(27) W. N. asks: What is the effect of sal soda on iron in steam boilers, also on the incrustation? A. The use of soda, with frequent blowing, sometimes prevents the formation of scale to a considerable extent, and does not ordinarily injure the iron.

(28) J. W. asks for directions for waterproofing any kind of closely woven goods, leaving it flexible and coloring it brown. A. Dissolve by aid of heat in a gallon of water 2 ozs. soap and 4 ozs. of glue. Saturate the fabric with this, and, after drying, treat it in a similar manner with a saturated aqueous solution of equal parts of alum, aluminum sulphate or acetate, and salt; dry at a temperature of about 80° Fah. A brown color may be given to the cloth in the operation by introducing the proper quantity of Bismarck brown into the second bath, or by adding a little ferrocyanide of potassium to the first, and a suitable quantity of copper sulphate to the last bath.

(29) Engineer writes: Will you please work out an example from the following formula for finding the points for an "adiabatic" curve on an indicator diagram: $x = b \times \left(\frac{a}{a'}\right)^{\frac{17}{16}}$. Where "$a$" represents the piston stroke to point of release (clearance added), and a', a'' a^n, any other such points; "b" represents the absolute pressure at release, and "x" the pressure at a', a'', a^n. Data: Cylinder 22″ x 44″. Clearance 0·0175 piston displacement. a=43·175. b=12·125. A. Suppose a'=21·5875. Then $\frac{a}{a'} = 2$. To raise this to the $\frac{17}{16}$ power:

Log. 2 =	0·3010300
Multiply by	17
Log. of 17th power of 2—	5·1176100
Divide by	16) 5·1176100
Log. of $\frac{17}{16}$ power of 2—	0·3198506
Add log. — 12·125—	0·0836817
Logarithm of pressure at a'	0·4035323

Corresponding number, pressure at a' — 25·324.

(30) H. R. B. writes: I have made a strong extract of walnut bark (from the nut), and it seems to contain a kind of mucilage which prevents its ready absorption by the article I wish to stain with it. Can it be removed? A. Heat the solution gradually to about 130° Fah., and, after cooling somewhat, add a small amount of aqueous solution of basic lead acetate (subacetate of lead—Goulard's water), cool, settle, and filter. Excess of lead salts remaining in the solution may be removed by saturating it with hydrogen sulphide, again filtering and heating until the liquid ceases to smell of the sulphide. This removes both the gummy and albuminous matters.

(31) W. J. C. asks for a process for filtering water in large quantity, say 40 barrels per day, the water being perfectly clear after filtered, if muddy before. A. See pp. 229, 299 (10), 331 (10), SCIENTIFIC AMERICAN, and 1748, 472, 455, 1363, and 1384, SCIENTIFIC AMERICAN SUPPLEMENT.

(32) C. H. H. writes: At a temperature of 80° some bands of pure rubber which I use have a tendency to adhere to a fabric. Is there a cheap method of treating the rubber so as to avoid this? A. See p. 48, SCIENTIFIC AMERICAN, current volume.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

E. B.—The curious vertebræ-like specimens are probably silicified fragmental remains of certain crinoids, abundant in some of the formations of the Niagara period. Crinoids grew on stems and had somewhat the form of a lily, hence have received the name of "stone lilies." Their cup-shaped body sent out five arms, often branching into as many thousands, each composed of a hundred little bones jointed together. The stalk was also jointed somewhat like the vertebræ of the spine. Additional specimens would be quite desirable in settling the question.—A. C. P.—It is a variety of black limestone or *lucullite*—the color is principally due to carbonaceous matters and iron oxide. It contains much alumina and silicic acid, and would probably take a fine polish. It does not contain notable quantities of phosphoric acid.—L. T.—The specimen is a tooth of the fossil shark *Lamna texana*, described by Roemer as occurring in the cretaceous fauna of Texas.—J. F. McF.—The residue contains *Pinnularia grandis*, *Tabellaria flocosa*, *Navicula cuspidata* and closterium. The large object is bog moss.

HINTS TO CORRESPONDENTS.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

E. R. W., H., P. D., H. B., and others, who desire replies to inquiries, should give full name and address.

Many of our correspondents make inquiries which cannot properly be answered in these columns. Such inquiries, if signed by initials only, are liable to be cast into the waste basket.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

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FOR WHICH

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June 4, 1878,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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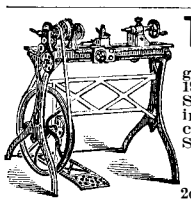

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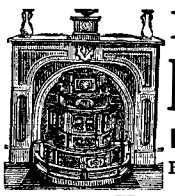

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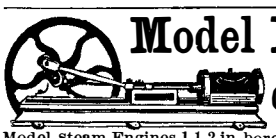

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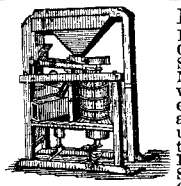

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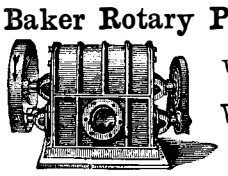

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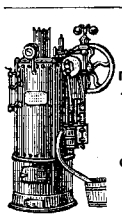

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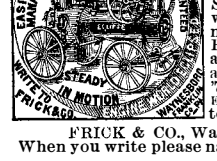

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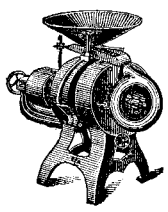

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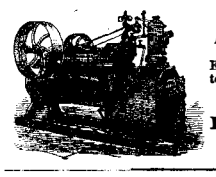

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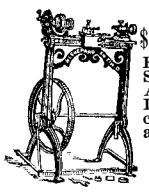

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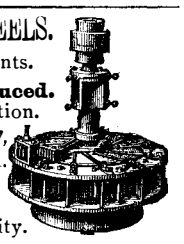

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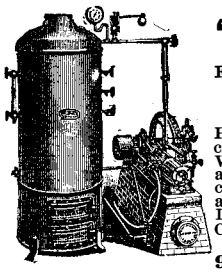

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